

# **Exploration Overview 1989**

## **Northwest Territories**

### **Mining, Exploration and Geological Investigations**

March 1990

NWT GEOLOGY DIVISION - NAP  
Box 1500 - Yellowknife



Indian and Northern Affairs Canada  
Affaires indiennes et du Nord Canada

**NWT GEOLOGY DIVISION STAFF**

**W. A. Padgham**  
Chief Geologist  
(403) 920-8211

---

***District Geologists***

James Seaton  
Bear - N. Slave Regions  
(403) 920-821

Walter Gibbins  
Arctic Islands Region  
(403) 920-8216

Dorothy Atkinson  
S. Slave - Cordillera Regions  
(403) 920-8221

Stephen Goff  
Keewatin Region  
(403) 920-8213

---

Carol Ellis  
Staff Geologist  
(403) 920-8220

Valerie Jackson  
Project Geologist  
(403) 920-8552

C. Diane Gault  
Archives Geologist  
(403) 920-8222

Arnold Enge  
Assistant Geologist  
(403) 920-8229

Emanuel I. Igboji  
Archives Technician  
(403) 920-8215

Kate Hearn  
Assistant Geologist  
(403) 920-8209

Maeva Rogers  
Office Manager  
(403) 920-8210

Trish Nickerson  
Geology Services Clerk  
(403) 920-8212

Bertha Mackenzie  
Archives Clerk  
(403) 920-8215

NWT Geology Division, NAP  
INAC  
Box 1500  
Yellowknife, NWT  
XIA 2R3

## TABLE OF CONTENTS

### Part 1: Exploration and Mining Overview, 1989

|                                                           |                         |    |
|-----------------------------------------------------------|-------------------------|----|
| <b>INTRODUCTION</b> .....                                 | W.A. Padgham .....      | 1  |
| Summary of Mining and Advanced Exploration .....          |                         | 1  |
| Summary of Mineral Exploration .....                      |                         | 1  |
| Exploration Highlights .....                              |                         | 5  |
| Geological Survey Work in NWT .....                       |                         | 5  |
| <b>CANADA-NWT MINERAL DEVELOPMENT AGREEMENT</b> .....     | Martin Irving .....     | 9  |
| <b>OPERATING MINES</b> .....                              | Carol Ellis .....       | 10 |
| <b>NORTHERN SLAVE STRUCTURAL PROVINCE</b> .....           | J.B. Seaton .....       | 12 |
| <b>SOUTHERN SLAVE STRUCTURAL PROVINCE</b> .....           | Dorothy Atkinson .....  | 13 |
| Indin Lake Area .....                                     |                         | 13 |
| Russell Lake Area .....                                   |                         | 13 |
| Courageous Lake Volcanic Belt .....                       |                         | 13 |
| Yellowknife Greenstone Belt .....                         |                         | 15 |
| Yellowknife Basin Area .....                              |                         | 15 |
| Cameron River and Beaulieu River Volcanic Belts .....     |                         | 15 |
| Camsell Lake Area .....                                   |                         | 16 |
| Indian Mountain Lake Area .....                           |                         | 16 |
| Other Exploration .....                                   |                         | 16 |
| <b>BATHURST BLOCK - SLAVE STRUCTURAL PROVINCE</b> .....   | Walter A. Gibbins ..... | 16 |
| <b>ARCTIC ISLANDS REGION - DISTRICT OF FRANKLIN</b> ..... | Walter A. Gibbins ..... | 16 |
| <b>CORDILLERA</b> .....                                   | Dorothy Atkinson .....  | 17 |
| <b>BEAR STRUCTURAL PROVINCE</b> .....                     | James B. Seaton .....   | 18 |
| <b>SOUTHEAST MACKENZIE DISTRICT</b> .....                 | Walter A. Gibbins ..... | 18 |
| Athapuscow Basin .....                                    |                         | 18 |
| Talston Magmatic Zone .....                               |                         | 19 |
| Nonacho Basin .....                                       |                         | 19 |
| Rae Province .....                                        |                         | 19 |
| Snowbird Lake-Ennedai Lake Volcanic Belt .....            |                         | 19 |
| Thelon Basin .....                                        |                         | 20 |
| Interior Plains .....                                     |                         | 20 |
| <b>DISTRICT OF KEEWATIN</b> .....                         | Arnold D. Enge .....    | 20 |
| Gold .....                                                |                         | 20 |
| Uranium .....                                             |                         | 20 |

---

## **Part 2: Preliminary Reports on Geological Work in the NWT**

Abstracts of Talks and Posters

|                                                                                                                                                                                                   |                                                                         |    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|----|
| <b>UPDATE ON THE GEOLOGICAL MAPPING OF THE ARCADIA BAY AREA, CORONATION GULF, NWT</b>                                                                                                             | A.P. Abraham . . . . .                                                  | 22 |
| <b>RECENT ADVANCES IN SM/ND, PB AND RB/SR STUDIES OF ARCHEAN GOLD DEPOSITS</b>                                                                                                                    | C.D. Anglin . . . . .                                                   | 23 |
| <b>PRELIMINARY REPORT ON THE GEOLOGY OF THE THIRD PORTAGE LAKE AREA, DISTRICT OF KEEWATIN</b>                                                                                                     | A.E. Armitage . . . . .                                                 | 24 |
| <b>STRATIGRAPHY, SEDIMENTATION, DOME AND BASIN BASEMENT-COVER INFOLDING AND IMPLICATIONS FOR GOLD: HAWK HILL-GRIFFIN-MOUNTAIN LAKES AREA, DISTRICT OF KEEWATIN</b>                                | L.B. Aspler<br>T.L. Bursey . . . . .                                    | 26 |
| <b>GEOLOGY OF THE WESTERN PLUTONIC COMPLEX, SOUTHWESTERN SLAVE PROVINCE</b>                                                                                                                       | D.J. Atkinson . . . . .                                                 | 26 |
| <b>A REVIEW OF RECENT MINERAL EXPLORATION AND MINING ACTIVITIES IN THE NORTHWEST TERRITORIES</b>                                                                                                  | Dorothy Atkinson . . . . .                                              | 27 |
| <b>GRAVITY INTERPRETATION OF THE BLATCHFORD LAKE INTRUSIVE COMPLEX</b>                                                                                                                            | T. Birkett<br>D. Sinclair<br>D. Richardson . . . . .                    | 27 |
| <b>REMNANTS OF EARTH'S OLDEST KNOWN CONTINENTAL CRUST, SLAVE PROVINCE, NWT, CANADA</b>                                                                                                            | S. A. Bowring<br>I.S. Williams<br>W. Compston<br>F.A. Podosek . . . . . | 28 |
| <b>GOLD-BEARING IRON FORMATION IN THE WHEELER LAKE BASIN</b>                                                                                                                                      | J. A. Brophy . . . . .                                                  | 28 |
| <b>1989 EXPLORATION AND MINING ACTIVITY IN YUKON</b>                                                                                                                                              | Trevor Bremner . . . . .                                                | 29 |
| <b>STRUCTURAL EVOLUTION OF THE GIANT SHEAR ZONE COMPLEX</b>                                                                                                                                       | Norm Brown . . . . .                                                    | 29 |
| <b>REGIONAL ANALYSIS OF JOINTS IN QUARTZ ARENITES OF THE KINGA FORMATION, EARLY PROTEROZOIC HURWITZ GROUP, HAWK HILL-GRIFFIN-MOUNTAIN LAKES AREA, DISTRICT OF KEEWATIN: IMPLICATIONS FOR GOLD</b> | T.L. Bursey<br>L.B. Aspler . . . . .                                    | 30 |
| <b>CU-CO-AU-U MINERALIZATION IN MAGNETITE-SPECULARITE MATRIX OF RHYODACITE BRECCIA AT DAMP PROSPECT AND ITS METALLOGENIC SIGNIFICANCE TO THE GREAT BEAR MAGMATIC ZONE</b>                         | M. Cannuli<br>J.A. Clime<br>M. Sawiuk<br>S.S. Gandhi . . . . .          | 30 |
| <b>DETAILED AIRBORNE GEOPHYSICAL SURVEYS (GAMMA-MAG-VLF) OF THE LUPIN, THOR AND RELIANCE AREAS, NWT</b>                                                                                           | B.W. Charbonneau<br>K.L. Ford<br>S.S. Gandhi . . . . .                  | 31 |
| <b>GEOCHEMISTRY (TILL, GOSSAN AND LAKE SEDIMENTS - Au AND PGE) AND SURFICIAL GEOLOGY OF THE FERGUSON, YATHKYED AND CONTWOYTO LAKES AREAS, NWT</b>                                                 | W. B. Coker<br>W. Spirito<br>R.N.W. DiLabio<br>B. Hart . . . . .        | 31 |



|                                                                                                                                                  |                                                                           |    |
|--------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|----|
| THE LARK DEPOSIT: AN ARCHAEOAN VOLCANOGENIC MASSIVE SULPHIDE IN THE BEAULIEU RIVER GREENSTONE BELT                                               | L. Covello . . . . .                                                      | 32 |
| THE PROGRADE AND RETROGRADE EFFECTS OF KENORAN DIAPIRISM ON THE YELLOWKNIFE GREENSTONE BELT                                                      | N.A. Duke<br>C.R. Nauman<br>R.L. Hauser<br>P.D. Strand . . . . .          | 32 |
| THE METALLOGENIC ASSOCIATION OF GOLD TO GABBRO SILL COMPLEXES IN THE SLAVE PROVINCE                                                              | N.A. Duke<br>C.R. Nauman<br>S.R. Newkirk . . . . .                        | 32 |
| MINERAL RESOURCE COMPILATION OF THE YELLOWKNIFE MINING DISTRICT, NWT, CANADA                                                                     | Hendrik Falck . . . . .                                                   | 33 |
| THE NATURE OF THE MARGINAL ROCKS OF THE MUSKOKX INTRUSION AND IMPLICATIONS FOR PGE MINERALIZATION                                                | Don Francis . . . . .                                                     | 33 |
| POTENTIAL FOR OLYMPIC DAM-TYPE Cu-Au-U-Fe DEPOSITS IN THE GREAT BEAR MAGMATIC ZONE                                                               | S.S. Gandhi<br>R.T. Bell . . . . .                                        | 34 |
| THE GEOLOGY OF THE HOPE BAY AND ELU INLET METAVOLCANIC BELTS NORTHEASTERN SLAVE PROVINCE, NWT                                                    | James Gebert . . . . .                                                    | 34 |
| PRELIMINARY GEOLOGIC INTERPRETATION OF SAR DATA YELLOWKNIFE-HEARNE LAKE AREA, NWT                                                                | W.A. Gibbins<br>C.E. Ellis<br>V.R. Slaney . . . . .                       | 36 |
| PRELIMINARY REPORT ON THE NORTHERN PART OF THE ELU INLET VOLCANIC BELT                                                                           | Walter A. Gibbins . . . . .                                               | 36 |
| GEOLOGY OF THE PISTOL BAY - MISTAKE BAY AREA: KAMINAK GREENSTONE BELTS                                                                           | S. Goff . . . . .                                                         | 36 |
| GEOLOGICAL RELATIONSHIPS IN THE NORTHERN PART OF THE YELLOWKNIFE GREENSTONE BELT                                                                 | H. Helmstaedt . . . . .                                                   | 37 |
| MINING TRAINING IN THE N.W.T.                                                                                                                    | Tom Hoefler . . . . .                                                     | 38 |
| YELLOWKNIFE VOLCANIC BELT, NWT CONSTRAINTS ON TIMING AND DURATION OF GREENSTONE BELT MAGMATISM AND DEFORMATION                                   | C.E. Isachsen<br>S.A. Bowring . . . . .                                   | 39 |
| GEOLOGY OF THE WILLINGHAM LAKE VOLCANIC BELT SOUTHERN KATHAWACHAGA LAKE MAP AREA (NTS 78L)                                                       | V.A. Jackson . . . . .                                                    | 39 |
| THE SLEEPY DRAGON COMPLEX IN THE FENTON LAKE AND BROWN LAKE AREAS, SLAVE PROVINCE: STRATIGRAPHY AND STRUCTURAL RELATIONSHIPS.                    | Donald T. James . . . . .                                                 | 41 |
| GEOLOGICAL SETTING OF STRATABOUND GOLD OCCURRENCES IN THE ARCHEAN FISH-HOOK - TURNER LAKES BELT, BATHURST INLET AREA, DISTRICT OF MACKENZIE, NWT | C.W. Jefferson<br>M.N. Henderson<br>J.R. Henderson<br>S. Schaan . . . . . | 42 |

**STRUCTURE, STRATIGRAPHY AND FACIES CHANGES IN AURIFEROUS IRON-RICH  
ARCHEAN SEDIMENTARY ROCKS OF NORTHEASTERN SLAVE PROVINCE, N.W.T.**

C.W. Jefferson  
R. Lustwerk  
M.B. Lambert  
S. Fumerton  
K. Hudson  
R.A. Olson ..... 42

**PRELIMINARY GEOLOGY OF THE TORP LAKE METASEDIMENTARY BELT, WESTERN  
BATHURST INLET (76 N/5,6,3)**

Robert M. Johnstone ..... 43

**SURFICIAL GEOLOGY OF KATHAWACHAGA LAKE AREA (SOUTH HALF; 76 L)**

Daniel E. Kerr ..... 44

**PRELIMINARY RECONNAISSANCE OF THE SURFICIAL GEOLOGY OF THE  
YELLOWKNIFE RIVER BASIN, NWT**

Daniel E. Kerr ..... 45

**CURRENT FIELD ACTIVITIES OF THE GEOLOGICAL SURVEY OF CANADA IN  
THE NORTHWEST TERRITORIES**

J.E. King ..... 45

**REGIONAL GEOLOGY OF THE CONTWOYT-NOSE LAKES AREA**

J.E. King  
C. Relf  
W.J. Davis ..... 45

**INTERACTIONS OF GRANITIDS AND PILLOW LAVAS AT THE IDA POINT GOLD  
SHOWINGS, N.W.T.**

Simon Leclair ..... 46

**GOLD OCCURRENCES IN THE INDIN LAKE SUPRACRUSTAL BELT**

John Morgan ..... 47

**LOWER PALEOZOIC TECTONIC DEVELOPMENT OF THE NORTHERN CORDILLERA  
AND ASSOCIATED LEAD-ZINC MINERALIZATION**

David W. Morrow ..... 47

**GEOLOGY OF THE GOLD-BEARING ZONES AT GEORGE LAKE AREA BACK RIVER  
REGION, NWT**

R.A. Olson ..... 47

**TECTONOSTRATIGRAPHY OF THE ARCHEAN ROCKS OF THE TAVANI AREA,  
KEEWATIN, NWT**

A.F. Park  
S. Ralser ..... 48

**RARE-METAL MINERALOGY OF THE LAKE ZONE AND ASSOCIATES SILICA-  
UNDERSATURATED ROCKS, THOR LAKE DEPOSIT, NWT**

D.R. Pinckston  
D.G.W. Smith ..... 49

**DIAGENESIS OF MIDDLE DEVONIAN PRESQU'ILE BARRIER - IMPLICATIONS  
ON ORIGIN OF DISSOLUTION VUGS AND BRECCIAS AT PINE POINT  
AND ADJACENT SUBSURFACE**

H. Qing  
E. Mountjoy ..... 49

**STRUCTURAL-METAMORPHIC STUDIES IN THE CONTWOYT-NOSE LAKES AREA:  
AN UPDATE**

C. Relf ..... 50

**SEDIMENTOLOGICAL EVALUATION OF THREE ARCHEAN METAQUARTZITE- AND  
CONGLOMERATE-BEARING SEQUENCES, SLAVE PROVINCE, N.W.T.**

R.J. Rice  
W.K. Fyson  
D.G.F. Long  
S.M. Roscoe ..... 50

**STRATIGRAPHY AND STRUCTURE OF A METASEDIMENTARY-VOLCANIC SEQUENCE  
AT BENIAH LAKE, SLAVE STRUCTURAL PROVINCE, NWT**

D. Roach  
W.K. Fyson ..... 50

**THE DAMP PROSPECT: VOLCANIC-HOSTED POLYMETALLIC (Cu-Fe-Co-U)  
BRECCIA MINERALIZATION**

M. Sawiuk  
M. Cannuli  
J.A. Climie ..... 51

|                                                                                                                                                                                                                  |                                                                  |    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|----|
| PRELIMINARY REPORT ON GEOLOGICAL MAPPING AT TURNER LAKE, NWT                                                                                                                                                     | S.E. Schaan<br>W.K. Fyson . . . . .                              | 51 |
| GOSSANS ON NORTHERN MELVILLE PENINSULA                                                                                                                                                                           | M. Schau<br>L.A. Dredge . . . . .                                | 52 |
| THE POLARIS LEAD/ZINC MINE                                                                                                                                                                                       | R.J. Sharp . . . . .                                             | 52 |
| DRIFT PROSPECTING FOR GOLD AND BASE METALS, KAMINAK-TURQUETIL<br>LAKE AREA DISTRICT OF KEEWATIN                                                                                                                  | W.W. Shilts<br>P.H. Wyatt . . . . .                              | 53 |
| STRUCTURAL, GEOCHEMICAL AND $^{40}\text{Ar}/^{39}\text{Ar}$ DATING CONSTRAINTS ON THE<br>FORMATION OF GOLD BEARING, METATURBIDITE HOSTED QUARTZ BRECCIA/<br>VEIN SYSTEMS OF THE SOUTH GORDON LAKE REGION, N.W.T. | T.R. Stokes<br>M. Zentilli<br>N. Culshaw<br>P. Reynolds. . . . . | 53 |
| GEOLOGY OF THE McCREA-DRYBONES LAKES AREA                                                                                                                                                                        | Mike Stubley . . . . .                                           | 55 |
| TECTONIC SYNTHESIS OF THE RANKIN INLET - CHESTERFIELD INLET REGION,<br>DISTRICT OF KEEWATIN, N.W.T.                                                                                                              | S. Tella . . . . .                                               | 56 |
| PEGMATITE DEPOSITS OF THE NWT; THE AYLMER LAKE AND MCAVOY LAKE<br>PEGMATITE FIELDS                                                                                                                               | P. Tomascak<br>P. Cerny<br>M. A. Wise . . . . .                  | 56 |
| GEOCHRONOLOGY OF GRANITOID ROCKS IN THE SLAVE PROVINCE AND THELON<br>TECTONIC ZONE                                                                                                                               | O. van Breemen . . . . .                                         | 57 |
| GOLD AND BASE-METAL MINERALIZATION IN THE ANIALIK AND HIGH LAKE<br>GREENSTONE BELTS                                                                                                                              | G. Vivian . . . . .                                              | 57 |
| CAN-MAC EXPLORATION LTD.'S MON PROJECT DISCOVERY LAKE AREA<br>YELLOWKNIFE GREENSTONE BELT NORTHWEST TERRITORIES                                                                                                  | Dave R. Webb . . . . .                                           | 57 |
| GEOLOGY OF THE DISCOVERY LAKE AREA YELLOWKNIFE GREENSTONE BELT<br>NORTHWEST TERRITORIES                                                                                                                          | Dave R. Webb<br>J.H. McDougall . . . . .                         | 58 |
| STRUCTURAL CONTROLS ON THE LOCALIZATION OF ORE ZONES WITHIN<br>THE YELLOWKNIFE GREENSTONE BELT                                                                                                                   | Dave R. Webb . . . . .                                           | 58 |

## INDEX TO TABLES

|                                                                                                                                  |    |
|----------------------------------------------------------------------------------------------------------------------------------|----|
| TABLE 1: MINERAL CLAIMS IN THE NWT, 1983 TO 1989 .....                                                                           | 2  |
| TABLE 2: GROUND STAKED BY GEOLOGICAL AREA, 1985 to 1989 .....                                                                    | 2  |
| TABLE 3: PROSPECTING PERMITS ISSUED 1979 TO 1989 .....                                                                           | 2  |
| TABLE 4: SUMMARY OF DIAMOND DRILLING IN THE NWT, 1987 TO 1989 .....                                                              | 3  |
| TABLE 5: COMPARISON OF ACTIVITY IN VARIOUS GEOLOGICAL PROVINCES AND SUBPROVINCES .....                                           | 4  |
| TABLE 6: 1989 EXPLORATION PROJECTS IN THE NWT BY GEOLOGICAL REGION .....                                                         | 4  |
| TABLE 7: GEOLOGICAL SURVEY OF CANADA ADMINISTERED PROJECTS CONDUCTED<br>UNDER THE CANADA-NWT MINERAL DEVELOPMENT AGREEMENT ..... | 5  |
| TABLE 8: NWT GEOLOGY PROJECTS 1989 .....                                                                                         | 7  |
| TABLE 9: 1989-90 GEOLOGICAL CONTRACTS .....                                                                                      | 8  |
| TABLE 10: PRODUCTION ESTIMATES FOR MINES OPERATING IN THE NWT DURING 1989 .....                                                  | 11 |
| TABLE 11: VALUE AND AMOUNT OF MINERAL PRODUCTION IN THE NWT, 1986 TO 1989 .....                                                  | 11 |

## INDEX TO FIGURES

|                                                                               |    |
|-------------------------------------------------------------------------------|----|
| FIGURE 1: CANADA-NWT MINERAL DEVELOPMENT AGREEMENT, GNWT .....                | 9  |
| FIGURE 2: MINES OPERATING IN THE NWT DURING 1989 .....                        | 10 |
| FIGURE 3: MINERAL EXPLORATION IN THE SLAVE STRUCTURAL PROVINCE, 1989 .....    | 14 |
| FIGURE 4: MINERAL EXPLORATION IN THE ARCTIC ISLANDS REGION, 1989 .....        | 17 |
| FIGURE 5: MINERAL EXPLORATION IN THE BEAR STRUCTURAL PROVINCE, 1989 .....     | 18 |
| FIGURE 6: MINERAL EXPLORATION IN THE SOUTHEAST MACKENZIE DISTRICT, 1989 ..... | 19 |
| FIGURE 7: MINERAL EXPLORATION IN THE KEEWATIN DISTRICT, 1989 .....            | 21 |

## Part 1

# EXPLORATION & MINING OVERVIEW

## INTRODUCTION

W.A. Padgham  
NWT Geology Division, INAC

Northwest Territories mines had a mixed year in 1989. Lower gold prices reduced the value of gold production and firm zinc prices allowed the base metal sector to do well.

Exploration was down significantly but the expected shift from gold to base metals was barely apparent. Gold was still the main target followed by uranium and base metals; silver and rare metals were minor targets.

## SUMMARY OF MINING AND ADVANCED EXPLORATION

Highlights of the NWT mining scene included rapid progress on the construction of the Neptune Resources 10,000 TPD mill on the Colomac property (31, Fig. 3) and the commissioning of a 200 TPD mill, at the Ptarmigan Mine by Tremanco Resources (42, Fig. 3). Tremanco's mill extracts free gold from quartz vein gangue by gravity (jig and shaking table). Sulphides, and any gold too fine for gravity sorting are removed by flotation. Neptune's mill will be a cyanide leach operation.

Eight mining plants operated and six mines produced ore in the NWT during 1989. Included is a new gold mill at Ptarmigan Mine which opened in June. Prior to this, ore was trucked 14 km to the Giant mill for processing. A gold ore milling/roasting plant and a tailings recycling plant were operated by Giant. NERCO Con operated a cyanidation mill and a separate arsenic treatment plant to treat arsenic trioxide produced during an earlier period when Con mined refractory arsenical ores. Echo Bay operated a cyanide gold mill at Lupin. Cominco and Nanisivik operated standard lead-zinc flotation mills at Polaris and Nanisivik respectively.

Advanced exploration highlights included completion of the shaft and drifting at Noranda-Total Energies's Tundra property (38, Fig. 3). Underground diamond drilling was completed in October and the operation was suspended. CAN-MAC drove a decline at the MON Property (43, Fig. 3) 50 km north of Yellowknife intersecting a 0.6 to one meter wide quartz vein averaging over 60 g/t Au. A bulk sample of over 3000 t is to be shipped to a Yellowknife area mill this winter. Cameron Mining Ltd. extended the decline on Burnt Island (46, Fig. 3) and mined a 2500 t bulk sample which will be trucked to a Yellowknife mill in early 1990.

Athabaska Gold Resources continued to report good results from the Nicholas Lake property (44, Fig. 3) 95 km north-northeast of Yellowknife. Athabaska is planning a \$5 million underground test of the nearly 1 million ton drill inferred circa 10 g/t deposit. Pending financing of this program, drilling, mapping and prospecting of the property will continue in 1990.

Uranengesellschaft continued to await permitting for its Kiggavik uranium operation (10, Fig. 7). Exploration, which has continued in the area of the deposit for some years, recently resulted in discovery of additional deposits that significantly increase (probably double) the potential life of the mine.

Highwood-Hecia await market analysis reports before making a final decision on the future of the Thor Lake (38, Fig. 6) Be-REE deposits in the Blatchford Lake intrusive complex.

The Back River Joint Venture continued intense exploration on its numerous properties in the Beechey Lake turbidite basin (28, Fig. 3). A new organization, the George Lake Joint Venture, has been created to administer the exploration and development of the gold deposits in the George Lake area (14, Fig. 3).

Two properties, the Mon on Discovery Lake, and the Burnt Island property in northern Gordon Lake saw underground exploration and bulk sampling.

## SUMMARY OF MINERAL EXPLORATION

Mineral exploration declined significantly during 1989 in the NWT. Tables 1, 3, 4, 5 and 6 document this decline.

Four factors contributed to this decline: the changes in flow through financing, the decline in the price of gold, the general weakness in the stock markets of North America and a freeze, on claim staking in selected, generally high mineral potential areas of the southern Slave Province. All contributed to making it more difficult to raise equity capital for NWT mineral exploration. The staking freeze which may be extended to areas in the south Slave and Deh Cho administrative districts, is part of the land claims settlement process for the Dene-Métis.



**TABLE 1: MINERAL CLAIMS IN THE NWT  
1983 to 1989  
Claims  
(Hectares)**

| Year | Recorded           | Cancelled          | Good Standing         |
|------|--------------------|--------------------|-----------------------|
| 1983 | 547<br>(330,592)   | 424<br>(703,289)   | 40,952<br>(3,114,606) |
| 1984 | 488<br>(240,900)   | 4,222<br>(472,323) | 36,528<br>(2,878,225) |
| 1985 | 461<br>(294,887)   | 6,565<br>(455,237) | 30,398<br>(2,704,790) |
| 1986 | 531<br>(360,361)   | 5,655<br>(339,468) | 25,226<br>(2,721,985) |
| 1987 | 843<br>(552,385)   | 6,031<br>(430,657) | 20,052<br>(2,829,403) |
| 1988 | 1,098<br>(739,928) | 4,448<br>(464,348) | 16,702<br>(3,115,083) |
| 1989 | 500<br>(321,633)   | 249<br>(153,818)   | 15,945<br>(3,155,551) |

**TABLE 2: GROUND STAKED BY  
GEOLOGICAL AREA, 1985 To 1989  
(Thousands of hectares)**

| Geological Area                | Year         |              |              |              |              |
|--------------------------------|--------------|--------------|--------------|--------------|--------------|
|                                | 1985         | 1986         | 1987         | 1988         | 1989         |
| Arctic Islands                 | 0.5          | 1.0          | 0.0          | 0.0          | 15.4         |
| Keelewin<br>(Rae & Hearne)     | 49.9         | 71.9         | 88.9         | 280.6        | 139.3        |
| SE Mackenzie<br>(Rae Province) | 8.7          | 1.0          | 1.9          | 22.0         | 1.9          |
| Slave                          | 231.3        | 209.5        | 372.4        | 423.5        | 203.8        |
| East Arm                       | 0.1          | 5.7          | 0.6          | 23.6         | 0.0          |
| Bear                           | 1.2          | 67.2         | 67.1         | 12.7         | 6.5          |
| Interior Platform              | 0.0          | 67.2         | 0.2          | 0.0          | 19.2         |
| Cordillera                     | 1.8          | 0.0          | 0.8          | 1.8          | 23.4         |
| <b>TOTAL</b>                   | <b>293.5</b> | <b>423.5</b> | <b>551.0</b> | <b>744.2</b> | <b>409.5</b> |

Claim staking was down by more than 50% over 1988 (Table 1). In spite of the withdrawal from staking of lands in the southern Slave Structural Province, the Slave was the area of greatest activity with 42% of all claims staked (Table 2). The Churchill ran a close second at 38%; 21% of all claims were staked in the Hearne and 17% in the Rae Provinces.

Only twenty-four Prospecting Permits were issued; just over half as many as in 1988, but three times as many as in 1987 (Table 3). As interest continued to be mainly on lands with gold potential, areas available for prospecting permits within such lands declines quickly, as DIAND does not issue permits on or adjacent to areas with active claims.

**TABLE 3: PROSPECTING PERMITS ISSUED 1979 TO 1989, IN VARIOUS GEOLOGICAL AREAS**

| AREA                               | YEAR        |           |           |           |           |           |           |           |          |           |           |
|------------------------------------|-------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|-----------|-----------|
|                                    | 79          | 80        | 81        | 82        | 83        | 84        | 85        | 86        | 87       | 88        | 89        |
| Arctic Islands                     | 0           | 10        | 2         | 53        | 87        | 10        | 15        | 3         | 0        | 0         | 3         |
| Cordilleran Province               | 6           | 11        | 9         | 12        | 7         | 0         | 0         | 0         | 1        | 0         | 0         |
| Churchill Province<br>(Rae/Hearne) | 72          | 57        | 54        | 17        | 1         | 10        | 11        | 26        | 5        | 37        | 18        |
| Bear Province                      | 36          | 17        | 4         | 3         | 0         | 0         | 5         | 2         | 0        | 0         | 0         |
| Slave Province                     | 0           | 3         | 4         | 6         | 1         | 5         | 22        | 0         | 0        | 8         | 3         |
| <b>TOTAL</b>                       | <b>114*</b> | <b>98</b> | <b>73</b> | <b>91</b> | <b>96</b> | <b>25</b> | <b>53</b> | <b>31</b> | <b>6</b> | <b>45</b> | <b>24</b> |

\* In previous MIRs only 99 permits were reported issued. The figures in this table are correct.

TABLE 4: SUMMARY of DIAMOND DRILLING in the NWT, 1987-1989<sup>1</sup>

| BY DISTRICT                    | 1987      | 1988            | 1989       |
|--------------------------------|-----------|-----------------|------------|
| Franklin (Arctic Islands)      | 28,504.0  | 25,988.1        | 19,758.80  |
| Kaewatin                       | 32,867.6  | 38,107.9        | 7,996.81   |
| Mackenzie                      | 128,868.5 | 121,333.6       | 133,166.13 |
| BY GEOLOGICAL AREA             |           |                 |            |
| Slave                          | 108,716.8 | 112,943.2       | 131,784.90 |
| Bear                           | 3,169.2   | 8,390.2         | 0.00       |
| Churchill                      | 46,964.5  | Rae 9,516.9     | 5,887.10   |
| Cordillera                     | 244.5     | Hearne 28,556.4 | 2,109.20   |
| Interior Platform              | 15,348.2  | 0.0             | 0.00       |
| Arctic Islands                 | 15,979.0  | 15,466.8        | 1,381.02   |
|                                |           | 10,521.8        | 19,758.80  |
| BY COMMODITY                   |           |                 |            |
| Uranium                        | 8,664.1   | 9,516.9         | 5,887.10   |
| Base Metals                    | 43,852.2  | 53,157.5        | 27,605.90  |
| Precious Metals<br>(Au mainly) | 133,164.7 | 113,524.4       | 134,230.64 |
| Tungsten & Rare Metals         | 0.0       | 3,519.5         | 0.00       |
| Platinum Group Elements        | 4,559.1   | 5,711.3         | 0.00       |
| SURFACE DRILLING               | 140,101.1 | 140,393.1       | 79,762.58  |
| UNDERGROUND DRILLING           | 50,138.9  | 45,036.5        | 81,158.16  |
| TOTAL DRILLING                 | 190,240.1 | 185,429.6       | 160,921.74 |

<sup>1</sup> data recorded in meters

All other areas saw a minor amount of staking. A group of claims were staked on the Caribou River in 95 C and D, just south of Nahanni Park where a placer gold discovery was recently made. Claims staked between Fort Providence and Rae-Edzo in the Interior Platform are believed to cover potential for kimberlite or related rocks which may contain diamonds.

Table 1 shows that the total area under claims grew by only 26,554 hectares (<1%) in 1989.

Table 2 shows the geological areas in which staking occurred. The Slave and Rae-Hearne Provinces (Kewatin District) were the main areas of staking which reflects the continued interest in areas of gold potential. Diamond drilling (Table 4) declined by 13%, and would have dropped much more but for the significant addition to underground drilling made by the Tundra Project of Noranda-Total Energol. Surface drilling was down by approximately 43%.

Underground drilling increased by at least 80%, mainly due to the Tundra Project.

Drilling statistics indicate a significant increase in drilling in the Slave Province, especially for gold and other precious metals. All other areas and commodities saw minor to significant declines.

Table 5 shows that exploration continued to be concentrated in the Slave Province which contains eighty five of the properties explored (73% of the total). This trend towards the concentration of work in the Slave began in 1984 and has continued.

In Table 6 those projects we are currently aware of are listed according to the geological area and commodity that we believe was the main target. Projects that contained a drilling component are in round brackets.



**TABLE 5: COMPARISON OF ACTIVITY IN VARIOUS GEOLOGICAL PROVINCES AND SUBPROVINCES**

| Geological Region           | NUMBER OF PROJECTS EACH YEAR |            |            |            |            |            |            |            |            |            |            |
|-----------------------------|------------------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
|                             | 79                           | 80         | 81         | 82         | 83         | 84         | 85         | 86         | 87         | 88         | 89         |
| Cordillera                  | 21                           | 29         | 24         | 12         | 11         | 11         | 7          | 4          | 2          | 1          | 5          |
| Arctic Islands <sup>1</sup> | 4                            | 7          | 24         | 16         | 11         | 17         | 13         | 6          | 1          | 2          | 3          |
| Keewatin <sup>2</sup>       | 48                           | 53         | 59         | 34         | 25         | 19         | 17         | 21         | 17         | 33         | 14         |
| SE Mackenzie <sup>3</sup>   | 13                           | 14         | 25         | 10         | 11         | 9          | 3          | 1          | 6          | 13         | 7          |
| East Arm                    | 6                            | 4          | 14         | 3          | 1          | 1          | 2          | 1          | 4          | 4          | 3          |
| Pine Point                  | 5                            | 6          | 6          | 3          | 2          | 1          | 2          | 1          | 1          | 0          | 0          |
| Bear Province               | 32                           | 22         | 24         | 10         | 11         | 2          | 3          | 6          | 3          | 11         | 3          |
| Slave Province              | 33                           | 29         | 42         | 25         | 44         | 57         | 92         | 90         | 89         | 93         | 92         |
| <b>TOTAL</b>                | <b>162</b>                   | <b>164</b> | <b>218</b> | <b>113</b> | <b>116</b> | <b>117</b> | <b>139</b> | <b>130</b> | <b>123</b> | <b>157</b> | <b>127</b> |

<sup>1</sup> Includes Baffin Island and Melville Peninsula, part of the Churchill Province, as well as the Arctic Archipelago

<sup>2</sup> Churchill Structural Province in District of Keewatin

<sup>3</sup> Churchill Structural Province in District of Mackenzie

**TABLE 6: 1989 EXPLORATION PROJECTS IN THE NWT BY GEOLOGICAL REGION**

| AREA           | Gold                 | Uranium      | Silver<br>Base Metals | PGE        | Rare &<br>other Metals | Total<br>Exploration | Mines<br>Operating<br>[Developing] |
|----------------|----------------------|--------------|-----------------------|------------|------------------------|----------------------|------------------------------------|
| Slave Province | 48 (32) <sup>1</sup> | 0            | 5 (8)                 | 0          | 0                      | 46 (40)              | 4 [2] Au                           |
| Keewatin       |                      |              |                       |            |                        |                      |                                    |
| (Rae)          | 0 (1)                | 2 (2)        | 0                     | 0          | 0                      | 2 (3)                | [1] U                              |
| (Hearne)       | 5 (2)                | 0            | 0                     | 0          | 0                      | 5 (2)                | 0                                  |
| SE Mackenzie   |                      |              |                       |            |                        |                      |                                    |
| (Rae Province) | 4                    | 1            | 3                     | 0          | 0                      | 8                    | 0                                  |
| Bear Province  |                      |              |                       |            |                        |                      |                                    |
| (Wopmay)       | 1                    | 0            | 1                     | (1)        | 0                      | 2 (1)                | 0                                  |
| (East Arm)     | 2                    | 0            | 1                     |            |                        | 3                    | 0                                  |
| Cordillera     | 4                    | 0            | 0                     | 0          | 0                      | 2                    | 0                                  |
| Arctic Islands |                      |              |                       |            |                        |                      |                                    |
| (Platform)     | 0                    | 0            | (2)                   | 0          | 0                      | (2)                  | 2 Pb & Zn                          |
| (Rae Province) | 0                    | 0            | 2                     | 0          | 0                      | 2                    | 0                                  |
| <b>TOTAL</b>   | <b>64 (35)</b>       | <b>3 (2)</b> | <b>12 (10)</b>        | <b>(1)</b> | <b>0</b>               | <b>79 (48)</b>       | <b>6 [3]</b>                       |

Numbers in round brackets indicate the number of exploration projects with diamond drilling.

Numbers without brackets indicate the number of exploration projects without diamond drilling.

<sup>1</sup> Includes 6 advanced projects, 4 with an underground component.

There was a significant reduction in properties examined, 117 (157 in 1988), and in properties drilled, 48 (69), which reflects the problems junior mining companies are experiencing in raising money. The decline is particularly apparent in the Keewatin district where only 12 properties were worked this year compared to 33 in 1988, a decline of just over 60%.

There was a slight shift to base metal exploration with 10 properties drilled and 12 others explored without drilling. Last year only 7 base metal properties were explored. Last year 121 properties were explored for gold whereas this year only 90 properties were explored, a decline of 26%.

#### EXPLORATION HIGHLIGHTS

Hidden Lake Resources has found numerous gold showings in amphibolitic iron formation in the Wheeler Lake domain, a small remnant of middle to upper amphibolite grade turbidite sediments surrounded by the Western plutonic complex 90 km north-northwest of Yellowknife.

The George Lake Joint Venture (formerly Back River Joint Venture) announced significant gold reserves on their claims around George Lake in the Back River - Beechey Lake turbidite basin (see Olson, page 47).

Noranda - Total Energold announced suspension of their Tundra Project because the grades encountered were too low for profitable production at the current price of gold.

Activity in the northern arc of the Yellowknife volcanic belt was a significant portion of Slave gold exploration. The geology of this area is extremely complex as it contains a

thick sequence of pre-Kam (Dwyer Formation) chert-magnetite iron formation quartzite and felsic volcanics, and Kam equivalent felsic and andesitic centres at Cian Lake and in the Discovery area. Four properties were drilled in this belt: Nicholas Lake, Viking, Goodwin Lake (Kam claims), and Mon where a decline and bulk sampling were also done. Plans to mine Crestaurum at the south end of this zone were announced by Tremfinc in the fall.

#### GEOLOGICAL SURVEY WORK IN NWT

Three government organizations conducted geological surveys in NWT during 1989. The Geological Survey of Canada (EMR) continued widespread work from its offices in Ottawa, Dartmouth, and Calgary. As well, numerous Canada-NWT Mineral Development Agreement supported projects were organized, managed and operated by GSC officers or contractors. These are listed in Table 7, and reported on briefly in Part 2 in this Overview.

Government of the NWT term employees and 5 contractors funded by the Canada-NWT MDA also conducted surveys in 1989. Three projects were underway in the Keewatin, (two in the Hearne Province and one in the Rae Province), and 9 in the Slave Province. These are listed in Table 3 and reported on in more detail elsewhere in this Overview.

The NWT Geology Division of INAC conducted mapping in the Russell-Slemon Lake area (85 O/4), in parts of the Kathawachaga Lake area (76 L), in the Reid Lake area at the east end of the Ingraham Trail (85 I/6 and 11), and in the Quyt Lake area (85 J/16), listed in Table 8. District geologists visited exploration camps and documented showings in various parts of the territory.

TABLE 7:

#### Geological Survey of Canada Administred Projects Conducted Under The Canada - Northwest Territories Mineral Development Agreement

##### Regional Geology (LCSD)

- |                                    |                                                                                                                                                                                                                                                                                                                                                                       |
|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Contwoyto - Nose Lake area      | J. King, C. Relf (Ph.D., Queens); field work directed at understanding the regional tectonic setting of Lupin-type mineralization.                                                                                                                                                                                                                                    |
| 2. Tavani Greenstone               | Tella; to map parts of 55 K/3, K/4, K/5, and K/6 at 1:50,000 scale with emphasis on geochemistry, geochronology, structure and stratigraphy. Tavani area poses special problems of differentiating Archean volcanic suites from closely associated Proterozoic rocks because of complex structural and stratigraphic relations.                                       |
| 3. Baker Lake - mapping & geochron | LeCheminant; to map and sample selected units for zircon U/Pb and Nd/Sm geochronology. Emphasis will be placed on establishing the age of supracrustal rocks with high potential for base metal and precious metal mineralization.                                                                                                                                    |
| 4. Mystery Lake Intrusive Suite    | R. Hildebrand, N. Reardon; Detailed mapping and sampling for geochemical and isotopic study of the Mystery Island Intrusive Suite and related alteration haloes in the Echo Bay-Port Radium area; minor work in the Camell River area. To ascertain the relationship of Port Radium-type mineral deposits to the intrusive suite.                                     |
| 5. Muskox Intrusion                | W. Baragar; detailed mapping, geochemical and petrological study of marginal rocks of the Muskox Intrusion and selected areas of the Coppermine lavas and Mackenzie dykes to constrain models of magmatic processes in large mafic magma chambers. Evaluate current models that relate PGE to chemical and mechanical interaction between different batches of magma. |
| 6. Cameron River                   | M. Lambert, D. James; map at 1:50,000 Cameron River volcanic belt north of latitude 63°, and make a structural and stratigraphic analysis of the volcanic belt and adjacent granitoid and sedimentary terranes.                                                                                                                                                       |

TABLE 7: continued

**Mineral Deposits (MRD)**

1. Gold Metallogeny - Slave  
Jefferson et al; to document the character of gold deposits of all types throughout the Slave Province in order to identify empirical exploration guidelines, improve genetic models, and assess the potential for gold deposits in areas where they have not been found.
2. Gold Metallogeny - Churchill  
A. Miller; detailed mapping of gold occurrences and deposits in the Henik Group greenstones and equivalents. Investigate the impact of Archean sedimentation-tectonism and Proterozoic tectonism on the distribution of gold mineralization. Compare the gold metallogeny of Churchill Province with that of the Slave Province.
3. South Nahanni tungsten/rare metals  
C. Jefferson; document tungsten, gold, silver, gallium and germanium in the South Nahanni River area by analyzing heavy mineral concentrates from stream sediments, and analyzing Ga and Ge contents of selected samples from Ag-Pb-Zn occurrences in the area.
4. PGE in ultramafic/mafic NWT  
L. Hulbert; characterize mafic-ultramafic bodies and their potential for magmatic sulfide (Ni-Cu-PGE) and oxide (Cr-Ti-V) deposits.
5. Rare Metals - Slave/Churchill/Bear  
W. Sinclair; document by mapping and geochemistry the rare metal distribution in certain mineral deposit types and potential in certain alkaline igneous provinces. To compare the geochemical signatures of these rocks to similar geological environments in Canada in order to assess and stimulate further exploration.
6. Pine Point/Polaris geology  
Polaris: R. Randall, Ph.D., Toronto; detailed underground and surface mapping and drill core logging; recognition and definition of regional and local marker horizons in host rocks; study of "internal sediments" to determine their age and origin.  
Pine Point: H. Ching, McGill; oxygen carbon, and hydrogen isotopes of gangue carbonates whose paragenetic relationships to ore have been established through previous studies, determine the source, composition, timing, and possible transport corridors of the four major types of fluids (seawater, stratafugic, hydrothermal, meteoric) recognized to have been involved in rocks and ore at Pine Point.
7. Clay Mineralogy - Uranium Churchill/Bear  
J. Donaldson, Carleton; To document and compare the authigenic clay mineralogy in the Thelon Formation (Churchill Province) and Hornby Bay Group (Bear Province). Using the clay mineralogy and chemistry document the relationship between diagenesis and uranium mineralization.
8. Metal Stressed Vegetation  
Using imagery map alteration in vegetation and till surrounding gold- and PGE-bearing goesans; detect spectral anomalies of gold and related trace elements and PGE in vegetation along prospective mineral belts; to integrate the biogeochemical response of stressed arctic vegetation with the geoscientific data base to aid in delineating belts of high mineralization potential.

**Quaternary Geology and Geochemistry**

1. Gold and PGE in till Churchill/Slave  
MRD, W. Coker; to identify how Au and PGE mineralization is reflected in the associated till and to demonstrate till geochemistry as an exploration method; to define patterns of glacial dispersal in areas of Au and PGE mineralization in central Keewatin and Contwoyto Lake area.
2. Gold and PGE /rare metals in till Kaminak Lake  
TS, W. Shlts; evaluate areas of gold (PGE and base metals) potential by analysis of archived and new samples; resample areas showing high potential for gold PGE.
3. Lake Sediment geochemistry  
MRD, E. Hornbrook; demonstrate the effectiveness of exploration geochemistry in detecting gold in the Yellowknife Supergroup in the Contwoyto Lake tundra area and the Yellowknife boreal forest.

**Exploration Geophysics**

1. Aeromagnetic Survey Whitehills Lake area  
Geophys.; produce aeromagnetic maps and VLF-EM profiles, scale 1:50,000 of lake.
2. Geophysics airborne surveys  
MRD, B. Charbonneau; provide a geophysical database for Lupin Au and Blatchford Lake (Thor Lake) beryllium and rare metal areas.

NWT Geology Division staff also provided technical and professional direction to the Canada-NWT MDA geological staff stationed in Yellowknife.

In addition, contracts were let to various university

researchers to conduct research and provide technical expertise and professional direction for NWT Geology Division and Government of NWT/MDA staff. These contracts and projects linked directly to them are listed in Tables 7, 8, and 9.

**TABLE 8 - NWT GEOLOGY PROJECTS 1989**

| <b>PROJECT</b>                                                                          | <b>DESCRIPTION</b>                                                                                                                                                                                           |
|-----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Geologist in charge (liaison)</b>                                                    |                                                                                                                                                                                                              |
| <b>1.INDIN VOLCANIC BELT</b><br>Dr. J. Morgan<br>(Dr. D. Atkinson)                      | Structural and stratigraphic studies to fit the numerous and varied gold deposits of this belt into the geology of the area and to elucidate the relations between the volcanic and sedimentary successions. |
| <b>2.YELLOWKNIFE VOLCANIC BELT</b><br>H. Falck<br>(Dr. D. Atkinson)                     | Structural and stratigraphic studies to fit the numerous and varied gold deposits of this belt into the geology of the area and to elucidate the relations between the volcanic and sedimentary successions. |
| <b>3.CARP LAKE (85 P)</b><br>Dr. M. Stubley<br>(Dr. D. Atkinson)                        | Mapping (1:50,000) of an area of complex geology with potential for various gold, silver and base metal deposits.                                                                                            |
| <b>4.ARTIC SOUND (76 N)</b><br><b>MARA RIVER (76 K)</b><br>R. Johnstone<br>(V. Jackson) | Mapping (1:50,000) of the lower Hood-James River, of an area that contains abundant turbidite sediments hosting Lupin-type (BIF) gold deposits.                                                              |
| <b>5.RIDEOUT ISLAND (76 O)</b><br>J. Gebert<br>(Dr. W.A. Gibbins)                       | Mapping (1:50,000) of an area with abundant volcanic rocks with native silver, VMS and gold potential.                                                                                                       |
| <b>6.TAVANI (55 K)</b><br>Dr. S. Goff<br>(Dr. W.A. Padgham)                             | 1:50,000 mapping of areas with abundant, presumably Archean, volcanic rocks (Rankin-Ennadai Volcanic Belt).                                                                                                  |
| <b>7.HEPBURN ISLAND (76 M)</b><br><b>KATHAWACHAGA LAKE (76 L)</b><br>V. Jackson         | 1:50,000 and 1:25,000 mapping of granite-greenstone terrains.                                                                                                                                                |
| <b>8.SLEMON LAKE (85 O/4)</b><br>V. Jackson                                             | 1:30,000 mapping of an area of volcanic rocks and sediments with BIF pyrite-pyrrhotite gold deposits in sediments.                                                                                           |
| <b>9.SLAVE PROVINCE (86 G)</b><br>Dr. W.A. Padgham<br>Dr. S.A. Bowring                  | Mapping and collecting material for geochronology and petrological studies of gneissic terrain (pre-3.5 Ga).                                                                                                 |
| <b>10.REID LAKE (85 V11)</b><br>J.B. Seaton                                             | Studies of turbidite-hosted mineral deposits in the western part of the Yellowknife sedimentary domain.                                                                                                      |
| <b>11.ELU INLET VOLCANIC BELT</b><br>Dr. W.A. Gibbins (77 A)                            | Mapping (1:50,000) of a volcanic belt in NE Slave Structural Province.                                                                                                                                       |

1 - 6 : Canada - NWT MDA Projects  
7 - 11: NWT Geology Division Projects



**TABLE 9: 1989-90 Geological Contracts**

| Advisors<br>(student/degree)                                 | University                               | 1989-90 Project                                                                                                                                                                       |
|--------------------------------------------------------------|------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. J.A. Donaldson<br>(Lindsay Hall, B.Sc.)                   | Carleton<br>University                   | Extend detailed studies of the volcanic and sedimentary rocks in the Giant Section and relate the results of this work to other units in the Yellowknife volcanic belt (85 J/8, J/9). |
| 2. Environmental<br>Consulting Services<br>(Dan Kerr, Ph.D.) | University of<br>Alberta                 | Reconnoitre surficial geology of the Yellowknife River Basin and map and study Quaternary sediments along the Arctic Coast of the NWT (Kathawachaga Lake to Elu Inlet).               |
| 3. S.A. Bowring<br>(Clark Isachsen,<br>Ph.D.)                | Washington<br>University of<br>St. Louis | Geochronological studies in the Slave Province and mapping related to geochronological sampling.                                                                                      |
| 4. H. Helmstaedt                                             | Queen's<br>University                    | Map and study sheeted dyke complexes in KAM Group (YK Volcanic belt), 85 J/9.                                                                                                         |
| 5. A. Lalonde<br>(Susan Schaan,<br>M.Sc.)                    | Ottawa<br>University                     | Study gold-deposit-hosting turbidite successions in lower James and Hood River areas, 76 K and 76 N.                                                                                  |
| 6. R.S. James<br>(Allen Armitage,<br>M.Sc.)                  | Laurentian<br>University                 | Study supracrustal rocks that have gold showings in the Tehek Lake area (56 D/, NW Keewatin District).                                                                                |
| 7. W.K. Fyson                                                | Ottawa<br>University                     | Study structure of supracrustal rocks in the Slave Province and relate the structural succession to gold metallogeny.                                                                 |
| 8. E. Spooner<br>A. Abraham                                  | University of<br>Toronto                 | Continue studies of quartz vein gold mineralization in the granitoid rocks of Aniak River granite gneiss.                                                                             |
| 9. M. Zentilli<br>T. Stokes                                  | Dalhousie<br>University                  | Complete laboratory studies on the turbidite hosted gold quartz veins and stockworks in the Burwash Formation around Gordon Lake.                                                     |
| 10. P. Cerny<br>(Tomachuk, M.Sc.)                            | University of<br>Manitoba                | Study rare metal pegmatites of the Aylmer Lake pegmatite field.                                                                                                                       |
| 11. W.K. Fyson<br>(D. Roach, Ph.D.)                          | Ottawa<br>University                     | Mapping of the Beniah Lake straight zone and quartzite-ultramafic sequences in the Beniah Lake area.                                                                                  |
| 12. J. Gebert<br>M. Jebrak<br>(S. Leclair, M.Sc.)            | University of<br>Quebec<br>(Montreal)    | Detailed mapping of an area around the Ida Point silver showings for M.Sc. thesis.                                                                                                    |
| 13. L. Aspler                                                |                                          | Study Aphebian rock of south western Keewatin to determine their gold and base metal potential and relate the rocks to Nanacho and Hurwitz Groups.                                    |

1 - 7 NWT Geology Division (INAC)

8 - 13 \*Canada - NWT MDA

# CANADA - NORTHWEST TERRITORIES MINERAL DEVELOPMENT AGREEMENT

Martin Irving  
GNWT

Energy, Mines & Petroleum Resources

The Canada-NWT Mineral Development Agreement (MDA) has now completed its second full year of operation.

All three programs of the MDA are effectively delivering a wide range of successful projects. The MDA Geoscience project areas are shown in Figure 1 and described in Table 8.

The Agreement is administered by a management group of W.A. Padgham (NWT Geology Division), George Patterson (EM&PR-GNWT), Al Clark (Mineral Policy - EMR Canada) and Kit Spence (ED&T-GNWT); Art Redshaw (DOE) is an ex-officio member. The management group reviews and approves all applications.

## CANADA - NWT MINERAL DEVELOPMENT AGREEMENT 1989 GEOSCIENCE PROJECTS

### GOVERNMENT OF THE NWT

#### GNWT GEOLOGISTS

- 13 PIPROL BAY/WHALE COVE - B. GOFF
- 14 TENEX LAKE - J. GOW
- 15 UPPER BEAUFORT - M. STURLEY
- 16 LOWER ROOD/JAMES RIVER - B. JOHNSON
- 17 HOPE BAY - J. CECIL
- 18 DOW LAKE - J. MORGAN
- 19 YELLOVEHNE - H. FAULK

#### CONTRACTORS

- 20 AKALIE RIVER
- 21 GORDON LAKE
- 22 SOUTH SLAVE PERMATHEN
- 23 KOTAE/PILOT LAKE
- 24 HOPE BAY/IDA POINT

### GEOLOGICAL SURVEY OF CANADA

#### MINERAL GEOLOGY

- 1 COMPTON LAKE/ROSE LAKE - KING/LOD
- 2 TAFAR GREENSTONE - TELL/LUD
- 3 TAFAR LAKE - LACROIX/LUD
- 4 MYSTERY ISLAND - HOLDEMAN/LUD
- 5 TUBES OFFSHORE - BARAGAN/LUD
- 6 CAMERON RIVER - LAMBERT/LUD

#### MINERAL DEPOSITS

- 7 SOUTH HANNAH - JEFFERSON/LUD
- 8 PCB in ULTRAMAFIC/MUSKIE - HULBERT/WRO
- 9 FIVE POINT/POLARIS - SANDERSON/WRO
- 10 GOLD METALLOGENY/SLAVE - JEFFERSON/WRO
- 11 GOLD METALLOGENY/CHURCHILL - MILLER/WRO
- 12 BARE METALS - SLAVE/CHURCHILL/SLAVE - MILLER/WRO
- 13 CLAY METALLOGENY/TRANSIT - MILLER/WRO

#### GEOPHYSICAL SURVEY & GEOSCIENCE

- 14 GOLD & PCB in TELL/KAMONAK LAKE - FULTON/WRO
- 15 GOLD & PCB in TELL - CHURCHILL/SLAVE - COLES/WRO

#### EXPLORATION GEOLOGISTS

- 16 AEROMAGNETIC SURVEY/WHITEHILLS - TERRY/GEOPHYS
- 17 GEOPHYSICS AIRBORNE SURVEY - CHARBONNEAU/WRO



Figure 1: Canada-NWT Mineral Development Agreement, GNWT.



Under the Geoscience program, thirty projects were undertaken across the NWT; most of these are multi-year projects. The GNWT/DIAND manages 11 projects, the GSC manages 17, and one is jointly sponsored. Funds available for the Geoscience program for 1989/90 are \$1.88 million.

The Northern Technology Assistance Program (NTAP) has four projects underway that will adapt mining and mineral technology to the northern environment. CANMET is providing the necessary scientific advice to the MDA management group for the implementation of the projects. This year \$300 thousand will be spent under NTAP.

The third program is the Northern Mining Information Program (NMIP). With a budget of \$76 thousand, eight projects are being implemented ranging from newsletters to teaching aids. This program will increase the awareness among Northerners of the opportunities available in the mineral industry and its importance to the economy of the NWT.

## OPERATING MINES

Carol Ellis  
Staff Geologist

Six mines operated in the Northwest Territories during 1989: four gold mines and two lead-zinc mines (Fig. 2). Production estimates for the mines are listed in Table 11. Lead and zinc concentrates continued to be shipped from **Pine Point Mine** during the year. **Neptune Resources** expects production from the Colomac deposit to commence in the second quarter of 1990. **Urangesellschaft** is seeking regulatory approval to develop the Kiggavik deposit.

Following the completion of the new C1 headframe at **Nerco-Con Mine**, just south of Yellowknife, the C1 shaft and B3 winze were rehabilitated to allow mining in the upper levels of the Campbell shear zone. Production was mainly from 3900' to 5500' levels; the 5700' level is being

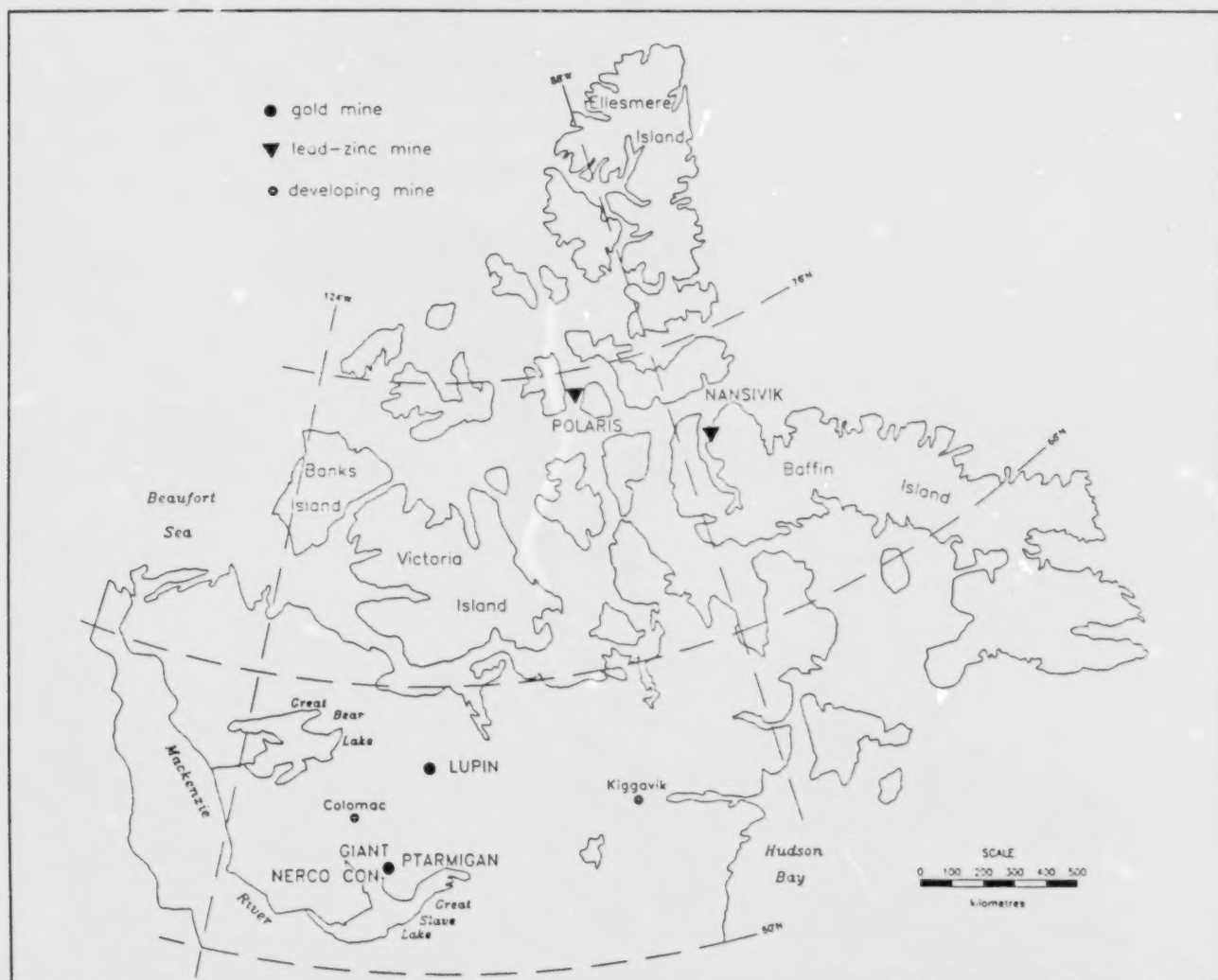


Figure 2: Mines operating in the Northwest Territories during 1989. Note: Colomac is in an advanced development stage.

**TABLE 10: PRODUCTION ESTIMATES FOR MINES OPERATING IN THE NORTHWEST TERRITORIES DURING 1989.**

| Mine      | Commodity             | Ore milled <sup>1</sup><br>1988 | Production <sup>1</sup><br>1988          | Reserves <sup>1,2</sup><br>Dec 31, 1988         | Ore milled <sup>3</sup><br>1989 | Production <sup>3</sup><br>1989           |
|-----------|-----------------------|---------------------------------|------------------------------------------|-------------------------------------------------|---------------------------------|-------------------------------------------|
| NERCO Con | gold                  | 194,000 t <sup>2</sup>          | 2425 kg Au <sup>2</sup>                  | 2,765,495 t <sup>3</sup><br>10.2 g/t Au         | 243,620 t                       | 2,992 kg Au<br>621 kg Ag                  |
| Giant     | gold mine             | 329,000 t                       | 2013 kg Au                               | 2,665,295 t <sup>3</sup><br>8.8 g/t Au          | 357,691 t                       | 3,378 kg Au<br>1,959 kg Ag                |
|           | tailings              | 857,000 t                       | 211 kg Au                                | 5.8 Mt<br>2.6 g/t Au                            | 1.097 Mt <sup>3</sup>           | 800 kg Au                                 |
| Ptarmigan | gold                  | 32,900 t <sup>4</sup>           | 540 kg Au <sup>4</sup>                   | 250,382 t <sup>3</sup><br>11 g/t Au             | 42,509 t                        | 432 kg Au                                 |
| Lupin     | gold                  | 678,900 t                       | 6296 kg Au                               | 3,572,000 t<br>10.8 g/t Au                      | 625,017 t                       | 6,083 kg Au<br>992 kg Ag                  |
| Nanisivik | zinc, lead,<br>silver | 676,000 t                       | 63,100 t Zn<br>1000 t Pb<br>22,200 kg Ag | 2,525,500 t<br>10.1% Zn<br>0.4% Pb<br>45 g/t Ag | 706,090 t                       | 57,328 t Zn<br>2,448 t Pb<br>16,956 kg Ag |
| Polaris   | zinc, lead            | 1,015,950 t                     | 134,860 t Zn<br>34,275 t Pb              | 13,970,570 t<br>14.2% Zn<br>3.8% Pb             | 1,024,946 t                     | 137,245 t Zn<br>31,599 t Pb               |

sources: <sup>1</sup> company annual reports

<sup>2</sup> yearly estimate based on monthly production figures submitted to the Mines Inspection Division, GNWT

<sup>3</sup> personal communication with mine staff

<sup>4</sup> fiscal year July 31, 1988 to July 31, 1989

<sup>5</sup> includes measured and indicated reserves

<sup>6</sup> includes inferred reserves, in addition to measured and indicated reserves

**TABLE 11: VALUE AND AMOUNT OF MINERAL PRODUCTION IN THE NWT, 1986 TO 1989**

| YEAR | GOLD<br>(kg) | SILVER<br>(kg) | LEAD<br>(kt) | ZINC<br>(kt) | VALUE<br>(\$ million) |
|------|--------------|----------------|--------------|--------------|-----------------------|
| 1986 | 12,233       | 27,899         | 138          | 417          | \$780                 |
| 1987 | 12,280       | 25,218         | 151          | 479          | \$843                 |
| 1988 | 11,834       | 24,234         | 65           | 292          | \$560                 |
| 1989 | 13,685       | 20,050         | 34           | 195          | \$598                 |

source for metal prices: Northern Miner

levels of the Campbell shear zone. Production was mainly from 3900' to 5500' levels; the 5700' level is being developed for production. In late October, a rock burst, which measured roughly 2 on the Richter scale, between the 5100' and 5300' levels in the Robertson shaft caused production to be suspended for 1 month. During this time, ore stockpiled on surface was used for millfeed.

Giant Resources Ltd. Canadian mining assets, which includes Giant Yellowknife Mines Ltd. are for sale. Gold recovery at the tailings 're-treatment' plant of Giant Mine, just north of Yellowknife, increased to over 30%. The tailing 'retreatment' plant operated from mid-May to the beginning of October. Conventional mining production was from the B-1 and A-1 open pits and underground; the C-trough area was added to the underground producing

areas. Ramp access continued to be developed to the 1500 level and a vent raise was driven from 1650 to 750 levels. A new dry was added in March and the wooden headframe for C shaft was replaced with a steel headframe in October.

The headframe at Tremanco Resources' Ptarmigan Mine, was completed in January and the hoist was installed in May. The shaft is operational to the 450' level and is being rehabilitated between 450' and 600' levels. A 200 tpd mill opened at the mine site in July. At the nearby Tom Mine, 1 km to the north, a decline was driven to the 225' level. In November Tremanco announced plans to mine Giant Yellowknife Mines Ltd.'s Crestaurum deposit, 14 km north of Yellowknife; a test sample will be mined from open pit in the near future.

At Lupin Mine, near Contwoyto Lake, shaft deepening to the 890 m level, completed in May, was followed by development of the Centre and West zones on this level. Production was from 250 m and 330 m levels of the East and West zones and from 410 m to 490 m levels of the Centre zone.

At Nanisivik Mine, on the Borden Peninsula of northern Baffin Island, roughly 30% of mill feed was from the Main Lens. The remaining 70% came from satellite ore zones: the Central and Eastern Lower lenses and Shale Hill deposit. The Oceanview deposit is being developed for production.

At Polaris Mine on Little Cornwallis Island, 6607 m of ore definition drilling was done during the first half of the year. The Central Keel zone was the main area of development and production, but pillars were being recovered in the South Keel and South Panhandle zones.

## NORTHERN SLAVE STRUCTURAL PROVINCE

J. B. Seaton

Properties explored are shown in Figure 3.

**Back River Joint Venture** which now comprises Homestake Mining Company, Kerr McGee Corporation and MacIab Group and is managed by Trigg, Woollett, Olson Consulting, flew geophysical (Aerodat) Surveys at (22) Nose Lake (Prospecting Permits 1168, 1169), (25) "Saw Lake" (SAW 1-4 claims), and in the Malley Rapids - "Needle Lake" (27) area (MR 1 and BRAU 61-69 claims), where anomalies were followed up by ground geophysics and prospecting.

**BHP-Utah Mines Ltd.** drilled and conducted detailed mapping, magnetometer, VLF-EM and a small amount of IP surveying on the CROWN claim (11) and the adjoining DEN claims (9) which were optioned from Aber Resources Ltd. To the south the PULSE claims were mapped and prospected.

**BHP-Utah** mapped and performed magnetometer, VLF-EM and IP surveys and did exploratory drilling on the ULU claims (10) west of the CROWN claims.

On the ARNICA claims and Prospecting Permit 1181 (2) in the Anialik River Belt, **BHP-Utah's** program comprised mapping and prospecting, magnetometer and VLF surveys.

West of Bathurst Inlet **BHP-Utah** prospected parts of Permit 1118 (6).

**BHP-Utah** mapped and prospected in the High Lake Volcanic Belt BRAVO (5) and CAIRO (4) claims, and staked the CYGNET claims (3). On the Hood River they mapped and prospected Permit 1146 (8).

**BHP-Utah** did a small amount of exploratory short hole drilling on the BRAD claims (17) northeast of Contwoyto Lake.

**Bre-X Minerals Ltd.** prospected anomalies outlined by a 1988 Questor airborne geophysical survey. Prospecting and sampling of locally auriferous iron formation on the ED claims (23) at Migration Lake and the RED claims (25) 30 km to the east was supplemented by reconnaissance mapping. Orientation magnetometer and VLF-EM surveys were completed at two locations. Following discovery of additional iron formation, the ED claim group was extended north to Ghurka Lake.

**Chevron Minerals Ltd.** trenched and sampled at the Turner Lake, TURNER and TURN claims property (6). Four "twin" drill holes were completed to check previous higher grade core intersections. Chevron sponsored a structural study at the Pistol Lake, FARN and KNUT claims (7) property.

**Cominco Ltd.** rock-sampled and carried out

magnetometer and HLEM surveys on the PRO claim (20).

**Cominco Ltd. - Cogema Ltd. Joint Venture** explored the COCO claims (21) northeast of Contwoyto Lake by drilling, 1:2,500 geological mapping, HLEM and magnetometer surveys. The JON claim (19) was also explored by drilling.

**Cominco Ltd.** in a joint venture with **Westview Resources Ltd.**, drilled, geologically mapped and rock-sampled on the REN claims (15).

**Continental Pacific Resources Ltd.** explored their properties in the High Lake and Anialik River belts, including the HIL and CHARLY claims (4), the CHAR, MIST and TAM claims (1) and the ALF and CHARLIE claims (5). Prospecting, sampling and 1:10,000 geological mapping was done on all of these claim blocks and selected areas, grids were constructed and surveyed mainly by magnetometer, VLF-EM and HLEM surveys.

**Contwoyto Goldfields Ltd.** did orientation soil sampling and rock geochemistry on the IF claims (19).

**Echo Bay Mines Ltd.** drilled in the Leanne Lake area (16) during the spring. They also drilled on the Lupin Mine lease.

A very large block of claims was recorded under the name of S.A. Eccott in the Exeter Lake area (28) following reconnaissance of an area underlain by metasediments and granitoids.

**Falconbridge Nickel Ltd.** explored the Hood claims (14) by lithogeochemical surveys. They relogged drill core and remapped selected areas.

**George Lake Joint Venture**, which holds claims which previously were owned by the Back River Joint Venture and comprises Homestake Mining Company Ltd. and Kerr McGee Corporation used three drills to test iron formation at three locales in the George Lake area (12). Magnetometer and VLF-EM surveys were conducted at five locales and geological mapping complemented geophysics or drilling in all but one locale. Magnetometer and VLF-EM surveys were done in the Boot Lake area (13) 25 km southeast of George Lake. Like the Back River Joint Venture from which it devolved, the George Lake Joint Venture is managed by Trigg, Woollett, Olson Consulting.

**Hecia Mining Company of Canada Ltd.** explored the JOHN, SHIN, DLER, CAMP, ADD claims (20) at Contwoyto Lake by geological mapping, prospecting, soil sampling and IP surveys.

**Orofino Resources Ltd.** drilled on the Arcadia property (1) on Coronation Gulf.

**Sirlus Energy Corporation** explored the Esker Lake, MUSKOX claims (24). Work included grid extension and ground follow-up of 1988 Questor airborne surveys and comprised drilling, trenching, magnetometer and VLF-EM surveys and geological mapping at regional (1:50,000) to



large scales used for trench mapping.

At the FIRE claims (26) in the Regan Lake - Fiddler Lake area *Sirius*' work was limited to resampling at anomalies outlined by a 1988 Questor airborne geophysical survey and 1:50,000 geological mapping.

## SOUTHERN SLAVE STRUCTURAL PROVINCE

Dorothy Atkinson

Properties explored are shown in Figure 3.

Gold was the principal exploration target in 1989. Properties explored covered a wide variety of geological settings including: auriferous iron formations; structurally controlled quartz veins and shear zones hosted by: various rock types, between lithologies with competency contrast and along iron rich zones at volcanic-sedimentary contacts. In the Beaulieu River-Sunset volcanic belt and Indian Mountain belt volcanogenic massive sulphides were the exploration target.

### INDIN LAKE AREA

Gold was the main exploration target in the area. Canada's largest gold mine under development is *Neptune Resources Corporation's* Colomac Mine (29), 212 km north-northwest of Yellowknife (86 B/6), continues construction on schedule with gold production due to begin in the second quarter of 1990. Annual gold production thereafter should average 6850 kg. Open pitable reserves for the deposit were announced in January 1989 as 25 Mt grading 1.9 g/t Au in the proven and probable categories. There is considerable potential to expand reserves along strike and at depth. Operations will consist of a large open pit mine and a 10,000 tpd conventional mill. The ore is metallurgically simple and a 95% gold recovery is expected. High-priority has been placed on hiring local people, particularly natives, to construct and operate the mine. An agreement has been negotiated with the Dogrib Tribal Council to give members of the Dogrib community first opportunity of jobs and entrepreneurial opportunities as they become available. Neptune continued exploration of its mine properties with fill-in reconnaissance mapping and detailed mapping and sampling of the Colomac and Goldcrest dykes, including approximately 5000 m of drilling. Ground geophysics were also conducted on the claims.

At Mesa Lake (86 B/4) *Noranda Exploration Co. Ltd.* completed line cutting, ground magnetometer, VLF, IP and soil sampling on the MESA 1-5 claims (30).

*Etruscan Enterprises Ltd.* (31) conducted magnetometer and VLF-EM surveys on the AZTEC, KING, GOLDEN PRINCE, INCA, SOUTH, INDIN and LEX claims (86 B/3, 6). Geological mapping, prospecting and sampling in the areas of conductors was subsequently completed.

On the INDIN claims (32) near Indin Lake (86 B/6) exploration by *Noranda Exploration Co. Ltd.* included

linecutting, ground magnetometer and EM surveys. At Norris Lake (86 B/5) on NOR 1-5, a base metal and gold prospect (33), *Noranda* completed magnetometer, EM surveys and approximately 500 m of drilling.

### RUSSELL LAKE AREA

Auriferous iron formations were again the exploration target in this area.

*Echo Bay Mines Ltd.* (34) drilled 1500 m on the SP claims, under option from *Aber Resources Ltd.* (85 O/4).

*Covello-Bryan and Associates* geologically mapped (1:30,000) and prospected for *Pacific Northwest Resources Inc.* (35) on the RUST, ISL, CHANCE, TIP and APEX claims (85 O/4).

*Fortune Minerals* had an airborne geophysical survey flown over the YELLER claims (85 O/6) followed by ground geophysics and prospecting (35).

In the Wheeler Lake area (85 O/7), 88 km northwest of Yellowknife, *Hidden Lake Gold Mines* completed reconnaissance mapping and prospecting on the GERM claims (36) and found iron formation along a 11 km strike length in the sedimentary basin. Three auriferous iron formation zones were gridded and mapped in detail. The highest assay to date is 34 g/t and a 3 m chip channel sample averaged 9 ppm.

### COURAGEOUS LAKE VOLCANIC BELT

Shear hosted gold deposits were the principal target.

Underground exploration continued in 1989 at the Tundra deposit (37), 240 km northeast of Yellowknife (76 D/3), a joint venture between *Noranda Exploration Co. Ltd.* (25.5%), operator, *Hemlo Gold Mines Inc.* (25.5%) and *Total Energold Corp.* (49%). Exploration includes: completion of the 476 m vertical shaft; 2000 m of u/g development on the 425 m level consisting of a drill drift paralleling the shear zone and 2 crosscuts, 6 raises, collection of 3 bulk samples and 28,500 m of u/g diamond drilling. Gold is intimately associated with fine grained, disseminated arsenopyrite within sericite alteration halos enveloping blue-grey quartz veins in a large shear zone. The north trending, near vertical shear zone has been recognized over a 1 km strike length, to a depth of 1 km and averages 200 m in width crosscutting Matthews Lake felsic pyroclastics, agglomerates and volcanoclastics. The complex geometries of the ore shoots within the shear zone are not yet fully understood. While the Tundra deposit represents a large gold inventory, present indications are that the grade encountered to date will not permit a production decision at this time. Surface exploration work at the Tundra property focused on an area west of the carbonate zone and consisted of gridding, ground magnetometer, VLF, EM and IP surveys as well as approximately 200 m of drilling.

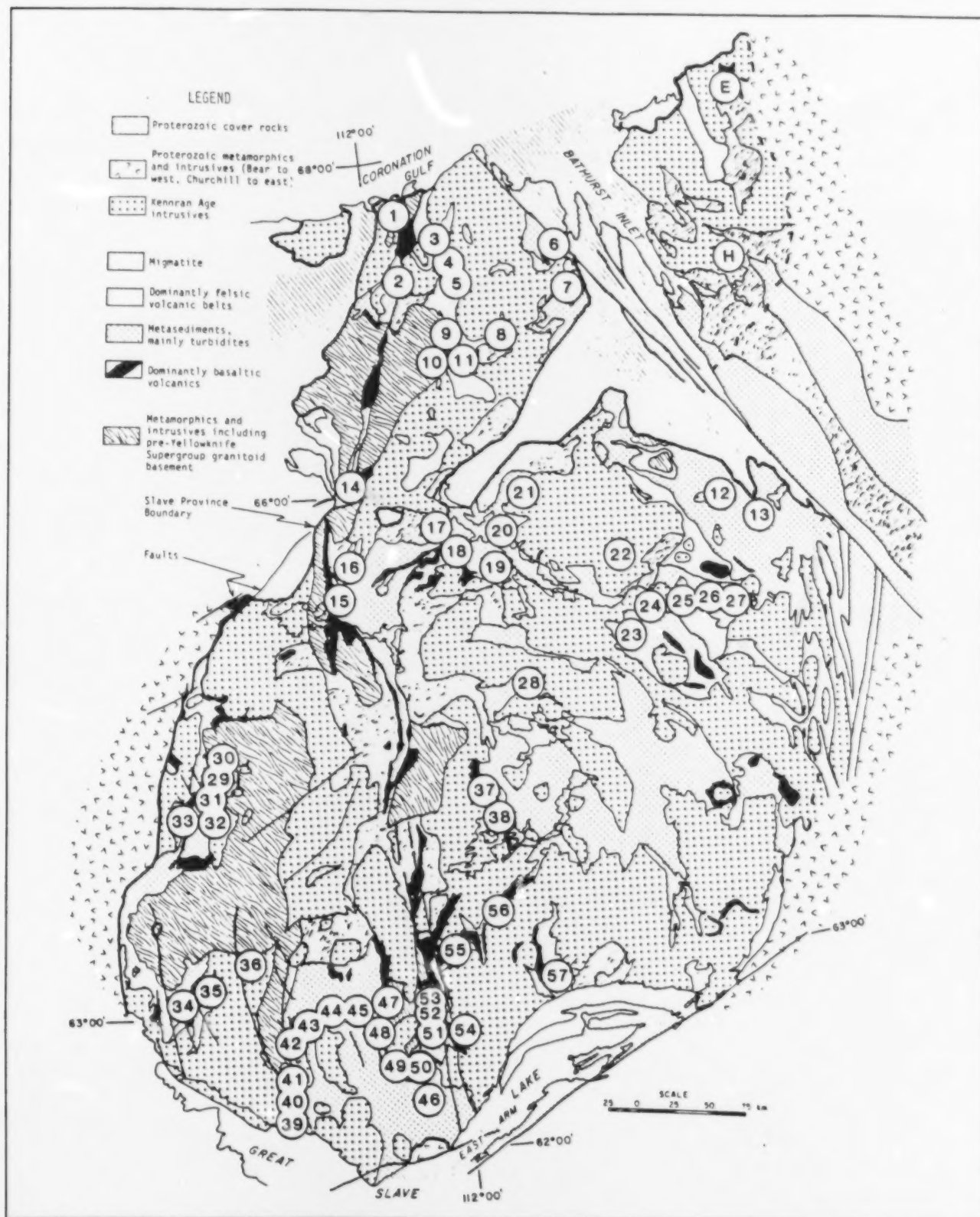


Figure 3: Mineral exploration in the Slave Structural Province, 1989.



**Battle Mountain** (38) conducted reconnaissance mapping, sampling, prospecting and ground geophysics on the MOG claims (76 D/3).

#### **YELLOWKNIFE GREENSTONE BELT**

Gold was the exploration target in the belt.

**Golden Marlin Resources Ltd.** drilled on the HOPE claims (39) in Yellowknife Bay (85 J/8) to test shear zones delineated by marine high resolution seismic surveys and IP. They also prospected and sampled land areas on the large MARLIN claim group.

**NERCO Con Mine Ltd.** continued to explore their mining leases which included w/g and surface drilling to test the Negus shear zone and Negus porphyry (39).

**Glant Yellowknife Mines Ltd.** completed 92 short holes (4000 m) to explore for open pitable reserves and are presently drilling 4 deep exploration holes from surface (40).

**Treminco Resources Ltd.** has reached an agreement with **Glant Yellowknife Mines Ltd.** to earn a 51% interest in the Crestaurum deposit (40), 14 km west of the Ptarmigan mine. Crestaurum has drill indicated reserves of 290,000 t grading 7.54 g/t Au. Treminco plans to conduct bulk sampling from open pits and process material at the Ptarmigan mill.

**Nathan Minerals Inc.** (41) conducted VLF and magnetometer surveys on their ANN and PRO claims (85 J/9).

**Keimet Resources Ltd.** continue to explore the Walsh Lake (85 J/9) property (41) by prospecting and drilling.

On the MON property (85 J/16) at the north end of Discovery Lake (42), 48 km north of Yellowknife, **CAN-MAC Exploration Ltd.** (NPL) drilled 1000 m to test auriferous quartz veins along a sediment-gabbro contact, followed by 100 m of underground exploration to obtain a 3000 t bulk sample which will be trucked to Yellowknife for custom milling this winter. Underground drilling resumed in November.

**Dave Webb** (42) prospected and mapped the NEL 1 claim (85 J/16).

At Sito Lake (85 J/16), **Noranda Exploration Co. Ltd.** (40) carried out a program of IP, detailed geology and soil sampling, as well as 700 metres of diamond drilling. On the CUR claims, near Sito Lake, **Noranda** also conducted an IP survey and drilled approximately 450 m.

#### **YELLOWKNIFE BASIN AREA**

Exploration was for gold in a variety of geologic settings.

**Treminco Resources Ltd.** (42) conducted exploration drilling on their mine leases (85 J/8) to explore the southwestern and northeastern extensions of the Ptarmigan

vein and drilled other parallel veins between the Ptarmigan and Tom veins. Treminco report ore grade intersections on the No. 2 vein. Exploration drifting on the Tom vein was continued.

**Keimet Resources Ltd.** conducted VLF and magnetometer surveys on CJ 2 and JAK 1 (85 I/10) and prospected the CADEN 1 claim (85 I/9).

**Hecia Canada Ltd.** re-sampled and assessed the gold and base metal potential of the KA 1-3 and PAN 1-2 (85 J/16).

**Aber Resources Ltd.** and **Continental Pacific Resources Ltd.** completed mapping, IP, and trenching on the VAD and VAD 1-3 claims (85 O/1) at Goodwin Lake and intend to test quartz-sulphide veins (43) by drilling this winter.

**Kamsal Mining Corp.** drilled the KAM 1-5 claims (85 O/1), west of Goodwin Lake (43).

**Canamax Resources Inc.** (85 P/4) mapped and drilled the VIKING property (43) south of the old Discovery mine.

**Athabaska Gold Resources Ltd.**, operator, and **Chevron Minerals Ltd.** continued exploration of their Nicholas Lake property (85 P/5), 90 km north of Yellowknife (44). Geologic mapping, ground and airborne IP, magnetometer and EM surveys, trenching and drilling of 42 holes (4072 m) was completed. Drill indicated reserves are 557,000 t grading 12.16 g/t Au to 1000 ft, using a minimum mining width of 1 m and a mining dilution of 0.5 m grading 0.88 g/t Au. Metallurgical tests indicate a 95% recovery rate. A new showing of quartz-sulphide veins 3 km to the southwest of the Nicholas Lake deposit was found during prospecting this summer.

At Burnt Island (85 P/3), Gordon Lake area, **Cameron Mining Ltd.** conducted an underground exploration program on **New Era Development Ltd.**'s property (45). Exploration included a decline to the 30 m level, drifting, slashing and raising on the No. 1 vein to obtain a 2500 t bulk sample to be shipped to Yellowknife for custom milling this winter.

**Mt. Grant Mines Ltd.** had preliminary mapping, prospecting and sampling on the Bullmoose Lake Gold Mine (85 I/7) completed (46).

**Hidden Lake Gold Mines** mapped, prospected and trenching on their leases and claims in the Ruth mine area (85 I/7)(46).

#### **CAMERON RIVER AND BEAULIEU RIVER VOLCANIC BELTS**

Exploration in the Cameron River volcanic belt concentrated on gold at the volcanic-sediment contact. Elsewhere, polymetallic volcanogenic massive sulphides were the exploration target.

North of Fenton Lake (85 P/2,3) on the LONGSPUR claims (47) **Freeport-McMoran Gold Company** drilled 9

holes for approximately 1220 m to test a gold showing and its strike extension at the contact between Burwash sediments and Cameron River volcanics.

On the Allan Lake Property (85 I/14), optioned from Durga Resources Limited, Noranda Exploration Co. Ltd. gridded and explored with magnetometer, Max-Min, soil surveys, detailed geological mapping and lithogeochemical sampling (48).

Pamorex Minerals Inc. (48) prospected the AP and RED claims (85 I/14).

Aber Resources Ltd. completed geologic mapping and geophysics on their polymetallic massive sulphide property in the Victory Lake area (85 I/11) and plans to drill the EMILY II claim this winter. Aber have also optioned claims from Noranda Exploration Ltd. that cover polymetallic showings which occur along strike and within similar volcanic rocks (49).

In the Turnback-Tumpline Lakes area (85 I/10) Strathcona Mineral Services Ltd. have optioned claims from Aber Resources Ltd. and Kelmet Resources Ltd. that cover base metal showings (50). Work included gridding, detailed geologic mapping, rock geochemistry, magnetometer, Max-Min and VLF ground geophysics as follow-up to airborne geophysics to define drill targets.

Hidden Lake Gold Mines Ltd. (50) completed prospecting on the JE claims south of Tumpline Lake (85 I/10).

Noranda Exploration Co. Ltd. conducted line cutting, prospecting, detailed geologic mapping and drilled one hole on the Sunset South claims (85 I/16)(51). Noranda also conducted prospecting, sampling and mapping in the Sunset Lake area (85 I/16) and drilled other base metal targets including, 1100 m on the SHEET claims (52) optioned from Kelmet Resources Ltd. 250 m on the SUN claims optioned from All Gold Mines Ltd. and 450 m on their FEDED property. Noranda also drilled 800 m and completed a gravity survey on their Sunset North property. At the Sunrise deposit (53) Noranda drilled 12 holes (3600 m) in April and completed magnetometer, EM and gravity surveys.

Continental Pacific Resources Inc. (54) continued to explore the Lark property (85 I/16). Two new showings of massive sphalerite-chalcopyrite were found during a program of prospecting, detailed geologic mapping and sampling. Geophysical surveys included IP, Max-Min and VLF-EM. Drilling of the Lark deposit will resume in early 1990.

Cominco Ltd. (55) explored the RUBY claims (75 M/5, 85 P/8) with mapping, prospecting and sampling.

#### **CAMSELL LAKE AREA**

Hidden Lake Gold Mines (56) completed regional prospecting on the NANCY, CAM, CINDY and CANOE claims (75 M/5, 6, 11, 12).

#### **INDIAN MOUNTAIN LAKE AREA**

At Indian Mountain Lake (75 M/2) 115 miles east-northeast of Yellowknife, Ego Resources Limited and Asquith Resources Inc. completed 3636 m of drilling on the BB Lake deposit (56) a volcanogenic massive sulphide deposit originally discovered in 1948. Drilling has both confirmed known grades and widths and has intersected ore at depths of greater than 300 m where previous geologic interpretations had the down dip continuation of the deposit faulted off. Ego Resources Ltd. plans to resume drilling in 1990 to test the depth potential of the BB Lake zone which has a 1969 reserve estimate to 198 m of 880,000 t at 9.5% Zn, 0.7% Pb, 116.6 g/t Ag; the Kennedy Lake zone, 500 m to the west, which has a 1969 reserve estimate to 76 m of 635,000 t at 6% Zn, 1% Pb, 171.4 g/t Ag; and the stratigraphic contact between volcanics and sediments between the two zones.

#### **OTHER EXPLORATION**

Pamour Minerals Inc. and Hidden Lake Gold Mines did separate grassroots exploration for gold and made property visits. Placer-Dome Inc. completed several property evaluations as did Inco Gold.

#### **BATHURST BLOCK SLAVE STRUCTURAL PROVINCE**

Walter A. Gibbins

Properties explored in 1989 are shown in Figure 3.

Prospector Lloyd Anderson prospected and staked claims in the Hiukitak River area (H) and the Elu Inlet volcanic belt (E).

#### **ARCTIC ISLANDS REGION (DISTRICT OF FRANKLIN)**

Walter A. Gibbins

Properties explored are shown in Figure 4.

In the Central Arctic, Cominco Ltd. drilled a zinc-lead deposit on Truro Island (1) and continued their ore delineation drilling at the Polaris Mine, Little Cornwallis Island (1). They also examined and staked favorable areas on Cornwallis Island (2).

Nanisivik Mines Ltd. continued to seek new ore at the Nanisivik mine property, Borden Peninsula, Baffin Island (3). They also did reconnaissance mapping, geochemistry and prospecting over a 15,000 square km area of north central Baffin Island (4) from a base camp at Mary River.

Comaplex Resources International Ltd. staked the THOM claim near Dewar Lakes, central Baffin Island (5).

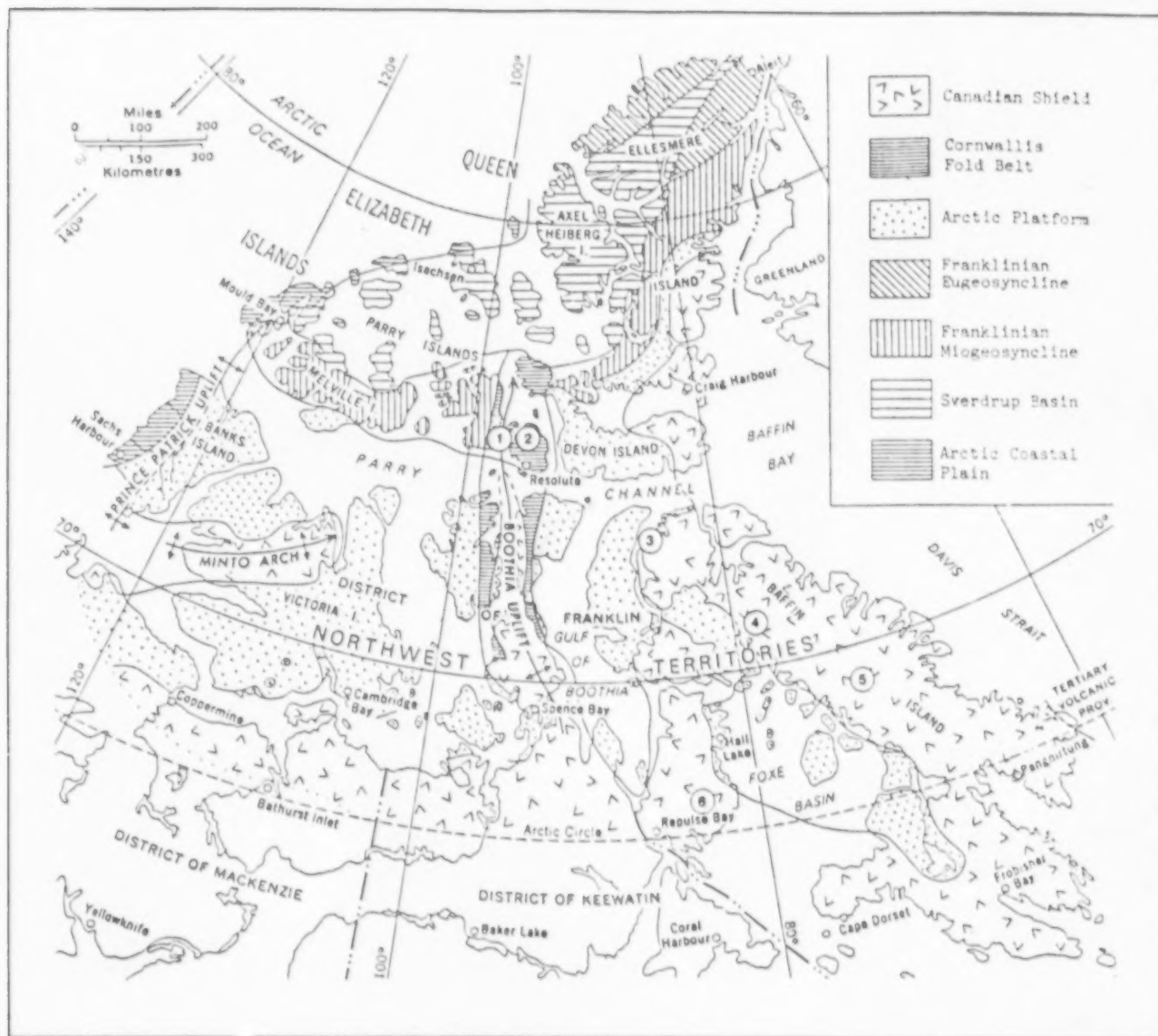


Figure 4: Mineral exploration in the Arctic Islands Region, 1989.

**Borealis Exploration Ltd.** explored prospecting permits near Nagvaak (Naguak) Lake, southeastern Melville Peninsula (6) NTS 46 P and O, for base metals.

### CORDILLERA

Dorothy Atkinson

Exploration in the Cordillera was for placer gold.

**Sirlus Resources Corp.** and **Verdstone Gold Corp.** explored the **SELENA CREEK** property (95 D/15; E/2). Samples from three test pits and a trench were sluiced and panned. Encouraging results were followed by staking of a

large claim block in the Caribou River area. To further assess placer potential in the area, **Wright Engineers Limited** were contracted to conduct a reconnaissance bulk testing program of a 3,000 metre length of Selena Creek. Fine gold was found throughout the gravels from surface to depth tested. Gold values appear to increase upstream. A seismic survey indicated the probable location of a buried channel. Gold values appear to be higher in the pits dug near this possible buried channel. No pit reached the interpreted channel bottom. The volume of potential gold bearing gravel is considered to be several million cubic yards. Several bulk samples are being processed and assayed by **Bacon, Donaldson Associates Ltd.**

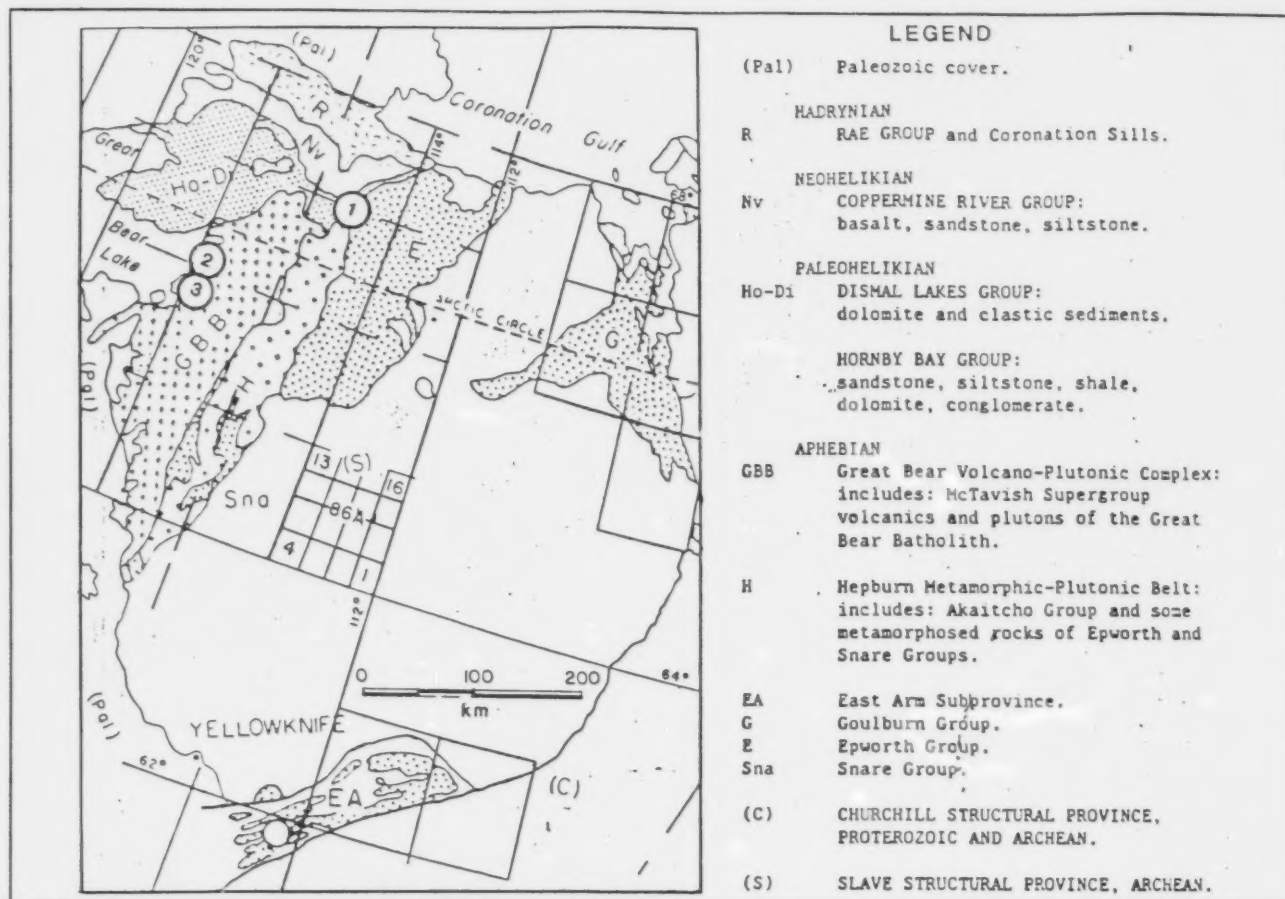


Figure 5: Mineral exploration in the Bear Structural Province, 1989.

Liard River Exploration and Mining Co. tested gravel bars by dredging and sluicing on their claims on the Liard River.

Procan Exploration Co. Ltd. geologically mapped and geochemically sampled the AX, DOG and MITERK claims (95 F/10).

M.R. Vullmirl completed geologic mapping, soil sampling and VLF surveys on the CHUCK 1 (95 D/15).

#### BEAR STRUCTURAL PROVINCE

James B. Seaton

Properties explored are shown in Figure 5.

CEGB Exploration (Canada) Ltd. flew an EM survey over the BUD (2), BULLY and BULLWINKLE (3) claims. Anomalies were followed up by ground geophysics, trenching and sampling on the BUD property where the target was epithermal gold. On the BULLY and BULLWINKLE claims the target was Port Radium type silver, uranium, copper, cobalt and nickel deposits. Geological mapping and prospecting was done on all three claims.

International Platinum Corporation drilled on the OX claims at the Muskox Intrusion (1) during early summer. The target was platinum group metals.

#### SOUTHEAST MACKENZIE DISTRICT

Walter A. Gibbins

Properties explored are shown in Figure 6.

#### ATHAPUSCOW BASIN

Leeward Capital Corp. explored gold prospects on the REX claims at Meridian Lake southwest of Fort Reliance (1).

Kelmet Resources Ltd. explored claims at Lac Duhamel near Snowdrift (2) and other parts of the east arm of Great Slave Lake.

MPH Consulting Ltd. did geophysical surveys of BBX Resources Ltd. claims near Taltchei Narrows (3A).



Development of the Thor Lake (3B) beryllium rare earth project of Highwood Resources Ltd - Hecla Mining Co. is awaiting a favorable marketing study.

#### TALSTON MAGMATIC ZONE

Carl Williams staked the O'Connor Lake lead-zinc deposit (4).

Prospector James Price did a radiometric survey of the REO claim (5).

At Rutledge Lake (6), BHP-Utah Mines Ltd. sampled and mapped nickel-copper-PGE prospects, optioned from Ennexco International Ltd.

#### NONACHO BASIN

Fortune Minerals Ltd. explored gold-silver-copper-lead-zinc deposits on the FD claims at Salkeld Lake (7).

#### RAE PROVINCE

Sold Resources Ltd, optioned, sampled, and mapped the Thyre Lake nickel-copper deposit (12).

#### SNOWBIRD LAKE-ENNADAI LAKE VOLCANIC BELT

Talga Consultants Ltd. conducted regional exploration for gold targets related to iron formation and massive sulphides on claims and prospecting permits near Snowbird Lake (9) and Atzinging Lake (11). This work was done on behalf of Courageous Exploration Ltd. on properties optioned from Comaplex Resources International Ltd. and Leeward Capital Corp.

W.A. Hubachek Consultants Ltd. did regional exploration in the Rochon Lake-Kasba Lake area (10) for Agnico Eagle Mines Ltd.

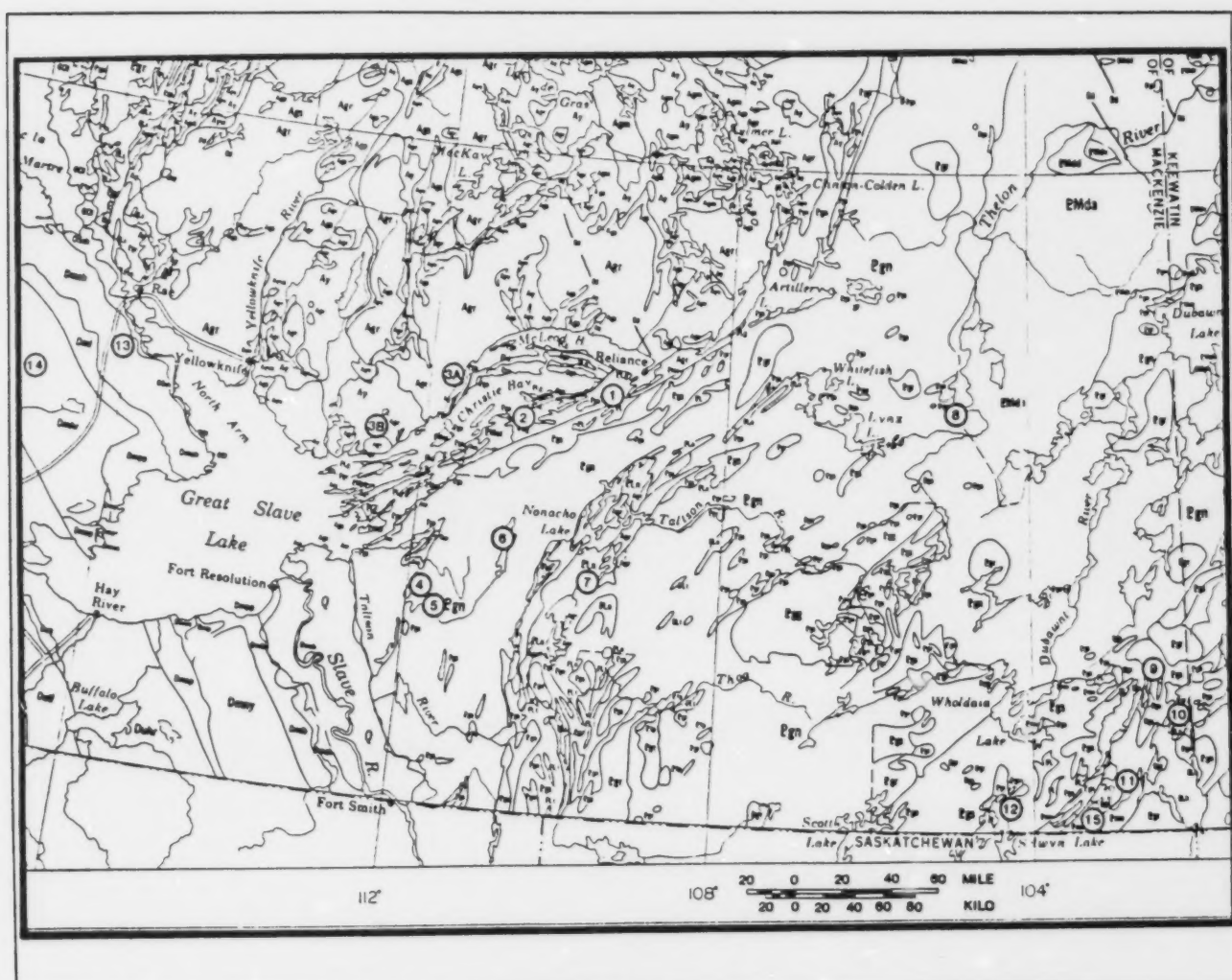


Figure 6: Mineral exploration in the southeast Mackenzie District, 1989.



**Athabasca Gold Resources Ltd.** sampled boulders on the ESK and ENN claims near the NWT-Saskatchewan border (15) for precious and base metals.

#### THELON BASIN

**B. Weir** of Yellowknife, staked the MING 1-2 claims near Boomerang Lake (8), to protect a uranium-gold prospect.

#### INTERIOR PLAINS

Several widely spaced claims (JUL 1-10 - 1700 ha) were recently staked in Phanerozoic cover and adjacent Precambrian rocks in the vicinity of the North Arm of Great Slave Lake (13), in NTS 85 J. They are owned by **759292 Ontario Ltd.**, a subsidiary of **Corona Corp.** An additional 32 claims (18,400 ha) have been staked by **BP Minerals Ltd.** near the eastern end of the Horn Plateau (14) in NTS 85 K and L. All of these claims are rumored to be kimberlite or lamproite targets.

### DISTRICT OF KEEWATIN

Arnold D. Enge

Mineral exploration is shown in Figure 7.

Exploration declined in proportion with the number of Prospecting Permits issued, down by two thirds with 11 in 1989, and 35 in 1988. The two main areas of exploration were for gold in the Archean Kaminak Group and uranium in Aphebian sedimentary rocks west of Baker Lake.

#### GOLD

**BHP-Utah Mines Ltd.** (2) continued exploration near Kaminak Lake on two prospecting permits and claims staked last year. Work included regional till geochemistry, prospecting, mapping, sampling, and geophysical surveys which included MaxMin, VLF/EM, aeromagnetics and DIGHEM.

**Comaplex Resources International Ltd.** (13) are exploring the Woodburn Group northwest of Tehek Lake at "Pipedream Lake". Exploration included magnetometer, VLF/EM and MaxMin surveys along with mapping, prospecting, sampling and diamond drilling (1500 m).

**Dejour Mines Ltd.** (3) operator of the Turquetil Lake Project in joint venture with **Noble Peak Resources Ltd.** explored their property with mapping, soil sampling and an IP survey over the main showing. Previous exploration outlined gold mineralization over a significant length and width.

**Inco Gold Ltd.** (7) returned to their IGLOO claims near Wilson Bay. Exploration included mapping, channel sampling, IP surveys and diamond drilling (1610 m).

**Noble Peak Resources Ltd.** (5) concentrated on the Southwin Venture property at Quartzite Lake. The Mac and

Cache Zones were the main targets of exploration which included mapping, prospecting, channel sampling, IP surveys, with the former being drilled (500 m).

**Noranda Exploration Company Ltd.** (1) explored the DEB, DEM and JEN claims near Otter Lake by prospecting, mapping, trenching and sampling.

**Sikaman Gold Resources Ltd.** continued operations at Kaminak (4) and Maze Lakes (6). Exploration of the KAM, MAZE and NORSIK claims included magnetometer surveys, detailed mapping and sampling in areas of geophysical anomalies and drilling done last year.

#### URANIUM

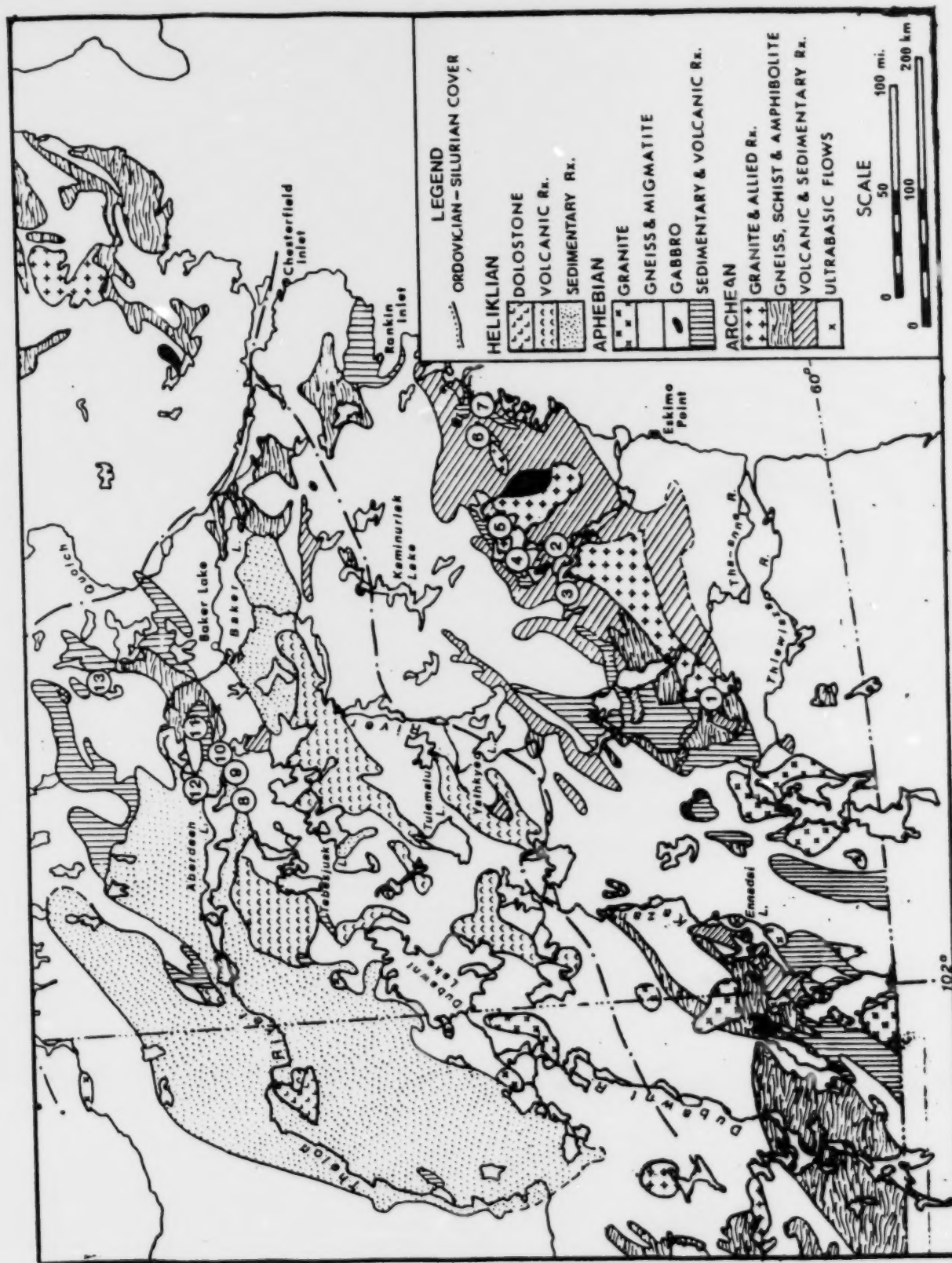
A positive feasibility study was given on the Kiggavik Project for joint venture partners **Urangesellschaft Canada Ltd.** and **C.E.G.B. Exploration (Canada) Ltd.** (10). Development of the open pit mine, south of Schultz Lake, is pending approval from a FEARO panel.

Joint venture partners **Urangesellschaft, C.E.G.B. and PNC Exploration (Canada) Ltd.** explored the North Sissons (9) property northwest of Judge Sissons Lake. Exploration of the three prospecting permits included mapping, DIGHEM IV, resistivity, gravity and radiometric surveys and over 5900 m of drilling.

**C.E.G.B. Exploration (Canada) Ltd.** (8) reconnoitred the BIFF claims south of Aberdeen Lake. Exploration comprised mapping, prospecting, airborne EM, DIGHEM IV surveys and sampling.

**PNC Exploration (Canada) Ltd.** in joint venture with **BP Resources Ltd.** (11) explored the L group of claims south of Schultz Lake with EM, magnetometer and gravity surveys. Over 1000 m was drilled.

**PNC and C.E.G.B.** are jointly funding exploration on the West Schultz project (12) with mapping, prospecting and sampling.



## Part 2

### PRELIMINARY REPORTS ON GEOLOGICAL WORK IN THE NWT ABSTRACTS OF TALKS AND POSTERS

#### UPDATE ON THE GEOLOGICAL MAPPING OF THE ARCADIA BAY AREA, CORONATION GULF, NWT

Andrew P. Abraham  
University of Toronto

The Arcadia Bay area lies at the northwestern point of the Slave Province, about 610 km north of Yellowknife, on the south shore of Coronation Gulf in 76 M/11. Approximately half of the mapped area is underlain by part of the Aniak River Batholith (previously called the Aniak River Granite Gneiss<sup>1</sup>) and the northwestern arm of the Aniak River Greenstone Belt<sup>2</sup>.

The initial 1987 mapping at 1:15,000 scale<sup>3</sup> was extended in 1988 to cover the Canuc Resources property and areas beyond its boundary (approximately 55 km<sup>2</sup>). Mapping and sampling in 1989 concentrated on the structural relationships of the Au-bearing shear zones.

Mineralization (860,000 tons grading 0.22 oz Au/t, Northern Miner, October 31st 1988) occurs in an approximately 32 km<sup>2</sup> area in the strongly to intensely foliated tonalite and marginal mafic rocks of the western part of the Aniak River Batholith. It is predominantly hosted by longitudinally extensive (up to 5 km strike length) narrow (typically less than 4 m wide) brittle/ductile shear zones containing mylonitized tonalite, associated mafic phases, "felsic" dikes and quartz veins. Two principal sets of shears are recognized; a north to northeasterly set trending predominantly 030° (eg. North Central, Sidewalk and C-vein systems) and a north-northwesterly set trending ~345° (eg. H-vein and Boundary Vein systems). Although quartz veins appear to have significant strike extension, it is important to note that they are in many cases closely spaced on echelon shear-type veins.

Rocks forming part of the Aniak River Greenstone Belt and the Aniak River Batholith have undergone at least four phases of deformation.

Primary volcanic and sedimentary features are variably preserved within the supracrustal belt, but their scarcity, accompanied by the intense folding and transposition of beds, prohibits their use in identifying consistent younging directions on a regional scale.

An early deformation (D1) in the supracrustals is defined by a pervasive foliation (S1) which appears to be parallel to primary lithologic layering. S1 is predominantly

north to northeasterly trending and moderately to steeply dipping to the west and northwest. Tight to isoclinal F1 folds have north to northeasterly trending axial surfaces which dip steeply to the northwest or southeast and which plunge predominantly to the south and southwest. Linear fabrics (L1), with moderate to steep, south and southwest plunges, are defined by preferred orientations of long axes of deformed volcanic fragments, as well as by mineral lineations, streaking and rodding.

A second generation foliation (S2), dipping steeply northwest and trending north to northeast, forms an axial planar fabric to F1 folds and transposes and crenulates the earlier S1 foliation. Supracrustals to the west of the "Sheeted Zone" appear to be in a domain of pervasive L2 linear fabric development (predominantly subvertical, west to southwest trending) characterized by axes of deformed volcanic fragments observed in fragmental units.

D2 ductile/brittle deformation is evident in locally developed, north to northeasterly trending, high strain zones. These zones are characterized by heterogeneous strain with S2 fabrics varying from well developed schistosity and augen structures to protomylonitic flaser textures and mylonitic and ultramylonitic hartschiefer banding.

The earliest deformational feature observed in the Aniak River Batholith is a moderate to strongly developed S1 foliation dipping moderately to steeply northwest to west, and striking north to northeasterly. F1 isoclinal folds, with north to northeasterly trending axial surface traces and shallow north-northeast and northeast plunges, are locally developed in the mesotonalite and western leucotonalite phases. A strong to intense predominantly northeast striking S2 foliation transposes these folds. A westward intensification in this fabric sub-parallel to the margin of the batholith, and a consequent increase in concentration of discrete mineralized zones of mylonitization both sub-parallel and oblique to the tonalite margin has been identified. The mineralized area is bounded by two major subparallel shear zones, the western Arcadia Creek and eastern Gray's Bay Shear Zone consistent with a horizontal component of dextral shear. Two other regional shears, sub-parallel to the above shears, occur to the east of the Gray's Bay Shear Zone, namely the Splitzen Lake and Aniak River Shear Zones<sup>4</sup>. S, C and C' fabrics are strongly developed and indicate that the majority of the mineralized shears show a horizontal sinistral sense of movement. This is corroborated by rotation of earlier S1 foliation into the shears and, in rare cases, by offset dikes. Kinematic indicators showing horizontal dextral movement, as seen in the major east and west boundary shears, are rarely observed in the mineralized shears.



The absence of mesoscopic linear fabric elements in the "Sheeted Zone" has been interpreted as a result of intense flattening initially produced during emplacement of the Aniak River Batholith into the supracrustals with subsequent translational movement<sup>4,5</sup>. The mineralized shears in the tonalite can be envisaged as being related to this flattening stage because of their sub-parallel alignment to the batholith margin. However, the earlier S1 foliation in the batholith, which has been interpreted as a product of the diapiric emplacement, is clearly observed to be rotated into the mineralized shears. These structures are more likely to post-date diapiric emplacement, and certainly postdate most felsic dikes intruding the tonalite, and thus represent a regional translational shearing event.

Late east-west trending faults, of probable Proterozoic age, exhibit dextral and sinistral offset of all earlier Archean fabrics and contain brecciated hematized wall rock fragments.

A pink, hematized, fault breccia with an associated intense hematite alteration envelope occurs along the western side of the valley formed in part by the Arcadia Creek Shear Zone. This fault is interpreted as a product of late Proterozoic reactivation along the Archean shear zone. Proterozoic reactivation of the mineralized shears cannot be ruled out.

#### Acknowledgements

This project is funded by the Canada-Northwest Territories Mineral Development Agreement 1987-1990. Additional support came from a NSERC strategic grant to E.T.C. Spooner (#G1802) which is acknowledged with appreciation.

#### References

- <sup>1</sup> Padgham, W.A., Roscoe, S.M., Van Schmus, W.R., and Bowring, S.A., 1983: Aniak Gneiss: 2.7 Ga-old anatectite, Slave Province, NWT, Geological Association of Canada Annual Meeting, Program with Abstracts, Victoria, B.C., p. 52.
- <sup>2</sup> Tirrul, R. and Bell, I., 1980: Geology of the Aniak River Greenstone Belt, Hepburn Island Map area, District of Mackenzie, in Current Research, Part A, Geological Survey of Canada, Paper 80-1A, p. 157-164.
- <sup>3</sup> Abraham, A.P.G., 1987: Preliminary report on the geology of the Arcadia Bay Property, Coronation Gulf, NWT; A granitoid-hosted gold deposit, 26p and map, Open File report E.G.S. 1987-8, Yellowknife.
- <sup>4</sup> Abraham, A.P.G., and Spooner, E.T.C., 1988: Tonalite-hosted Au-quartz vein/shear zone mineralization, Arcadia Bay, Coronation Gulf, NWT, 16th Annual Geoscience Forum, Yellowknife, NWT, 1988, Abstracts of Papers, p. 21-25.

- <sup>5</sup> Abraham, A.P.G., and Spooner, E.T.C., 1989:

Co-structural, syn-shear felsic dikes and Archean Au-quartz veins in shear zones within the Aniak TTG tonalite batholith, Arcadia Bay area, Slave Province, NWT, Geological Association of Canada Annual Meeting, Program with Abstracts, Montreal, Que., p. 46.

#### RECENT ADVANCES IN SM/ND, PB AND RB/SR STUDIES OF ARCHEAN GOLD DEPOSITS<sup>1</sup>

C.D. Anglin  
Geological Survey of Canada

Several isotopic methods are being examined for determining the age of vein gold deposits in Archean rocks, including; Sm/Nd and Sr isotopic compositions of vein scheelites; trace lead isotopic compositions of pyrite from alteration zones around veins, and Rb/Sr isotopic composition of sheared rocks hosting these vein systems.

Sm/Nd isotopic analysis of scheelites from gold deposits in the Timmins and Val D'Or areas have yielded ages significantly younger than the host rocks to these deposits. Seven samples of scheelite from the Hollinger-McIntyre-Coniaurum gold veins at Timmins yield an excellent Sm/Nd isochron (MSWD = 1.9), defining an age of  $2404 \pm 29$  Ma and an initial  $^{143}\text{Nd}/^{144}\text{Nd}$  ratio of 0.50969. Preliminary Sm/Nd data from the Sigma and Perron-Pascalls Mines in Val D'Or also define a good linear array which defines an age of approximately 2590 Ma for the time of vein scheelite formation. This latter age is in very good agreement with U/Pb rutile ages obtained recently at the ROM (Wong et al, 1989) for time of hydrothermal mineralization at the Sigma Mine. However, the Timmins age is controversial, and is not in good agreement with Ar-Ar work that has been done on alteration fuchsite (Masliwac et al, 1985) which defines an older age of mineralization than does the Sm/Nd data for the scheelite. The applicability of the method is presently being examined with samples collected at the Nerco Con Mine, Yellowknife, this past summer.

Lead isotope analyses of five samples of alteration pyrite from mineralized felsic porphyritic intrusions in the Geraldton area yield a linear array on a  $^{207}\text{Pb}/^{204}\text{Pb}$  vs  $^{206}\text{Pb}/^{204}\text{Pb}$  isotope diagram. Interpreted as a "whole rock" continuous addition isochron, the slope of this line corresponds to an age of  $2534 \pm 35$  Ma. The U/Pb zircon age of these intrusions is  $2691 \pm 3/2$  Ma, more than 100 Ma older than the age of gold mineralization indicated by the lead isotopes. Therefore, no direct magmatic-hydrothermal link between these rocks and the gold mineralization is apparent. A similar study of alteration pyrite from the Perron-Pascalls Mine yields a preliminary isochron age of  $2545\text{Ma} \pm 20$  Ma which is in agreement within analytical error with an Ar-Ar date on a vein muscovite from the Sigma Mine (Wong, et al, 1989). The reason that the muscovite and pyrite yield younger ages than the rutile and scheelite probably reflects the lower closure temperatures of these minerals.



Rb/Sr analyses of highly sheared rocks are often useful as a technique for dating time of deformation and alteration. This is being tested on a series of mineralized samples from the Giant Mine in Yellowknife.

<sup>1</sup> Contribution to N.W.T. MDA Project C1.2.1 carried by Geological Survey of Canada

## PRELIMINARY REPORT ON THE GEOLOGY OF THE THIRD PORTAGE LAKE AREA, DISTRICT OF KEEWATIN

A.E. Armitage<sup>1</sup>  
Laurentian University

### Introduction

The Third Portage Lake area is approximately 80 kilometres north of Baker Lake in the southeast corner of the Amer Lake area (66 H/1). Rocks in the southern half of the Amer Lake have most recently been mapped by Ashton (1988) and who assigned the name Woodburn Lake Group. The Woodburn Lake Group is Archean in age and consists of a sequence of metavolcanic rocks and related metasedimentary rocks, and quartzites. The metavolcanic rocks are dominated by felsic to intermediate tuffs and flows; also lesser amounts of mafic and ultramafic volcanic rocks are present. Metagabbroic rocks of several ages are locally common as sills and dykes throughout the volcanic sequence. Metasediments consist of greywackes and oxide facies iron formations. Ashton suggests that the quartzite unit is the youngest of the Archean supracrustal sequence.

The Woodburn Lake Group has been intruded by a late Archean granitoid plutonic complex consisting of coarse grained granite. Late biotite porphyry dykes crosscut the metavolcanic sequence and some of the granites. Ashton's research indicates that the metamorphic grade has reached the biotite zone of the greenschist facies in most of the area, and the lower amphibolite facies adjacent to the granitic complex.

The geology in the Amer Lake area has been complicated by up to six phases of deformation (Ashton, 1988). Primary sedimentary layering is poorly preserved. The main regional foliation is generally northeast-striking and has a variable dip. This regional foliation has been folded several times. Field measurements used by Ashton to determine the phases of deformation include foliations; intersection, extension, and stretching lineations; and fold axes.

### Geology of the Third Portage Lake Area

The main bedrock in the area consists of interlayered metavolcanic and metasedimentary rocks with associated iron formation and orthoquartzite. Primary volcanic and sedimentary layering in these supracrustal rocks is scarce. Due to folding and variable dips and dip directions of the foliation, thicknesses of the units are difficult to determine

These rocks have been intensely folded and faulted at various scales; several phases of deformation have been identified. The metavolcanic rocks are dominantly felsic to intermediate; minor mafic varieties, shallow intrusions (gabbro), and ultramafic and volcanoclastic rocks are also present. They crop out in the southwest and central portions of the map area. Large gabbroic bodies are found in the southeast and northern parts of the area. Ultramafic rocks are typically found associated with the iron formation.

Greywacke and iron formation dominate the eastern half of the map area. To the north iron formation consists of interlayered bands of magnetite and chert and minor disseminated pyrite mineralization. To the south, grunerite occurs commonly in the cherty bands of the iron formation and pyrite, pyrrhotite, and arsenopyrite are common. Contacts between the iron formation and the volcanic/sedimentary sequence are conformable.

Quartzite, found in the western and the northern sections of the map area, is dominantly a white massive rock with relatively scarce and discontinuous layers of white mica. Its contact with the volcanic/greywacke-iron formation sequence appears to be faulted; conical folding is common at these contacts. Ashton (1988) suggests that the boundary between the quartzites and the older volcanic units is an unconformable contact which has been the loci of shearing but no significant displacement.

### Unit Descriptions

#### Metavolcanic Rocks

The intermediate rocks weather grey-brown to green and are dominantly chlorite, quartz, and feldspar. Foliations are defined by chlorite. Carbonate filled fractures occur throughout this unit. Felsic rocks weather light grey to pink and are massive, consisting of quartz and feldspar with lesser amounts of chlorite.

Mafic rocks appear to occur as dykes and sills within the intermediate volcanic rocks. The mafic rocks are dark green on weathered surface and contain mainly chlorite with disseminated pyrite and magnetite, and carbonate filled vugs. Minor pyroxenite dykes also occur in the metavolcanic units. They are dark green and are dominantly recrystallized to medium-grained chlorite and actinolite which form radiating patches.

#### Metagabbro

In the north the metagabbro weathers light to dark green, is fine to medium-grained, and consists of chlorite, epidote, amphibole, and plagioclase. It is strongly sheared with zones showing relict gabbroic textures. Carbonate veins are present as well as disseminated blue quartz eyes.

In the south the metagabbro weathers dark green, is medium-grained and contains chlorite, amphibole, and plagioclase and minor amounts of K-feldspar and blue quartz eyes. The gabbro body is foliated near its margins and becomes more massive towards the center. The rock is

highly fractured with K-feldspar and epidote alteration along the fracture surfaces. Also present are rare granitic veins up to 3 cm wide. These alteration features probably resulted from the emplacement of younger, late Archean coarse-grained granite plutons.

#### Ultramafic Rocks

Most of the ultramafic rocks are light green-grey to brown chlorite and talc schists with associated serpentine, and carbonate. In one outcrop relict spinifex texture was observed on a weathered surface. A small massive ultramafic body in the northern part of the area weathers black and is dominantly recrystallized to serpentine and talc. Also present at this locality are veins up to 6 cm thick of fibrous serpentine.

#### Greywacke

The greywacke ranges from a dark grey-black massive rock to a light green-grey phyllitic schist. The former rock type consists of quartz, biotite, chlorite, and feldspar. It is poorly foliated but some minor layering is defined by feldspar clasts up to 2 mm in diameter. Disseminated pyrite cubes and blue quartz eyes are common.

The light green-grey phyllitic schist is strongly foliated; chlorite defines the foliation. Quartz and feldspar are major components. Also present are disseminated pyrite and blue quartz eyes. Within this unit are more massive quartz-feldspar layers. Some feldspar clasts in these layers are up to 3 mm in diameter.

#### Iron formation

The iron formation consists of bands of magnetite and chert; minor chlorite and stilpnomelane is common in these rocks in the northern part of the area. To the south grunerite and stilpnomelane occur commonly in the chert layers. Chert and magnetite bands range from 1 mm-2 cm in thickness and are generally fractured and offset. In some parts of the iron formation the chert bands pinch and swell and in some zones the iron formation is dominantly magnetite. The iron formation in the south contain pyrite, pyrrhotite, and arsenopyrite and are iron stained. The mineralization is both disseminated and in chlorite-quartz veins. Disseminated pyrite occurs throughout the iron formation.

#### Orthoquartzite

The orthoquartzite form high linear ridges in the study area; it is white on fresh and weathered surfaces. It consists of fine grained quartz and scarce discontinuous layers of white mica which defines the foliation. Fuchsite is disseminated in the white mica layers. Bedding and other primary structures in the quartzite were not observed in the study area.

#### Granitic Rocks

Late Archean granitic rocks intrude the Archean volcanic/sedimentary units in the extreme southern and western part of the map area. It is coarse-grained, unfoliated, massive, inequigranular and consists of quartz, plagioclase, K-feldspar, and up to 10% mafics. It generally shows a pink weathered surface. Sheared granites also occur within the volcanic/sedimentary units. These contain coarse porphyroclasts of quartz and feldspar in a quartz, feldspar, biotite matrix. The rock is strongly foliated with foliation wrapping around the porphyroclasts. This rock is interpreted as a sheared version of the coarse-grained granite in the south and west of the study area.

#### Lamprophyre

At one locality a 1 m wide N-S trending lamprophyre dyke was found within a gabbro unit. It is dark grey to black and consist of medium- to coarse-grained biotite in a fine grained matrix. Pyrite cubes up to 1 cm across are found in a zone in the gabbro extending for approximately 1 m on either side of the lamprophyre.

#### Metamorphism

Chlorite in the volcanic unit and biotite in the greywackes are the highest grade metamorphic minerals present. This suggests the grade of metamorphism is no higher than the biotite zone of the greenschist facies. However, while the iron formations in the north contain only chlorite and stilpnomelane, those in the south contain grunerite; which suggests that the grade of metamorphism is higher in the southern part of the map area. Evidence supporting this contention comes from the mafic and ultramafic rocks. To the north they contain tremolite/actinolite whereas in the south these rocks contain blue-green hornblende.

#### Structure

Several stages of deformation were identified in the field from foliations, folds, and intersection lineations. The foliation in the area is generally north-south with variable dips and dip directions. Further north in the map area the foliation changes to a northeast trend and southeast dip. The foliation is defined by mica and chlorite. Bedding and layering is poorly developed and/or preserved in the volcanic and sedimentary units. Within the southern intermediate volcanics a strong mylonitic fabric has developed parallel to foliation. Within this fabric are isoclinal folds with axial planes parallel to the mylonitic fabric.

The regional foliation has been folded about gently north and south plunging closed folds. These closed folds have been folded by broad open folds plunging steeply to the east and west. Both sets of folds have been identified in all sedimentary and volcanic units.

Conical folds were found at the contact between the quartzite and volcanic/sedimentary units. These are open folds plunging to the northeast and southwest. Similar conical folds were also found in the iron formation. These conical folds have been refolded by the broad open folds previously mentioned.

Joint planes were measured in the area but single prominent set was not identified. Several northwest-southeast trending faults were identified displaying limited offsets. All units are locally sheared.

### **Economic Potential**

Magnetite-chert iron formation is abundant in the study area. Grunerite-bearing iron formations and chlorite-quartz veins contain disseminated pyrite, pyrrhotite, and arsenopyrite.

### **References**

Ashton, K.E., 1988. Precambrian geology of the southeastern Amer Lake area (66H/1), Near Baker Lake, N.W.T.. A study of the Woodburn Lake Group, an Archean, orthoquartzite bearing sequence in the Churchill Structural Province. A Ph.D. thesis, Queen's University, Kingston Ontario, Canada.

<sup>1</sup> Progress report on geological work in the NWT.

## **STRATIGRAPHY, SEDIMENTATION, DOME AND BASIN BASEMENT-COVER INFOLDING AND IMPLICATIONS FOR GOLD: HAWK HILL-GRIFFIN-MOUNTAIN LAKES AREA, DISTRICT OF KEEWATIN <sup>1</sup>**

L.B. Aspler  
Ottawa, Ontario  
T.L. Bursey  
Carleton University

The Hurwitz Group represents aborted rift (Padlei Formation glaciogenic ? conglomerate and fluvial conglomerate, arkose and siltstone) and cratonic basin (Kinga Formation granulestone and quartz arenite) sedimentation that was interrupted by emergence (Hawk Hill Member siltcrete) and drowning (Ameto Formation slate and arkose). Shoaling-upward sequences in the Ameto, Watterson, Ducker and Tavani formations, with short-distance lateral facies changes, indicate repeated development of short-wavelength bulges and depressions. The bulges and depressions are either collision-related, thrust load-induced (forebulge/foredeep model) or non-collision related, intraplate stress-induced.

Proterozoic shortening was by thick-skinned basement-cover infolding rather than detachment. NW-trending, upright, concentric D1 folds are refolded by E and NE-trending upright (and locally inclined), concentric, D2 folds, generating dome and basin (and locally mushroom) interference patterns. Interference is inferred to be a consequence of superposed folding, with active north-south shortening overprinting northwest structures. It is uncertain if the interference represents episodic versus polyphase deformation. Folding was primarily by flexural slip; minor thrusts, cross faults, joints, disharmonic folds, and fold and cleavage fans are space-accommodating. Changes in

basement rock type and structural grain provided anisotropies that influenced Hurwitz thickness and facies and guided Proterozoic deformation.

Structural analysis, and prospecting during mapping, have provided a context for known Au deposits in the area and opened new exploration targets. Structural control of py-asp-cpy-Au: in jointed Kinga quartz arenite at sheared basement-cover contacts (similar to the past gold producer near Cullaton Lake, "Shear Lake deposit") and near cross faults (Watterson Formation) suggests a genetic link between folding, cross faulting, jointing and Shear Lake-type mineralization. Geometric constraints of concentric folding suggest intrabasement detachment; there may be a similar genetic link between Proterozoic shortening and intra-Archean, Cullaton "B Zone" mineralization. In the past, the primary targets in the area have been the Archean supracrustal sequence (especially BIF) and jointed Kinga quartz arenite. A value of >10,000 PPB Au from quartz-pyrite-veined, sheared Watterson Formation calcareous arkose, suggests that units higher in the Hurwitz Group, adjacent to favourable structures, are also potential hosts.

<sup>1</sup> Contribution to the Canada-NWT Mineral Development Agreement, supported by Geological Survey of Canada (Project C 1.2.2), Indian and Northern Affairs Canada (Yellowknife) and Government of the NWT.

## **GEOLOGY OF THE WESTERN PLUTONIC COMPLEX, SOUTHWESTERN SLAVE PROVINCE <sup>1</sup>**

D.J. Atkinson  
University of Western Ontario

The Western plutonic complex is the southernmost exposure of a granitoid batholith extending for over 500 kilometres along the western edge of the Slave Structural Province. It is a composite body ranging in composition from gabbro through granite and bounds the Yellowknife greenstone belt to the east. The complex, originally referred to as the Western Granodiorite by Jolliffe, 1942, was subdivided by Henderson, 1985, into: the Anton complex, a partly older, possibly basement terrain; the younger intrusive Defeat, Stagg and Awry plutonic suites; and the two youngest Prosperous and Duckfish granite bodies.

New geological mapping compiled at 1:50,000 scale supports further reorganization of parts of the Western plutonic complex. Defeat plutonic suite rocks west of the Yellowknife greenstone belt are remapped as part of the older Anton complex. The rocks are conformable and intrusive into sub-Kam supracrustals. Anton rocks are strongly deformed, dirty granites hosting a variety of enclaves, schlieren, and locally 3 phases of granite. Small layered gabbro bodies within the complex appear to represent feeder chambers to Kam Group gabbro sills, dikes and mafic volcanics. Associated bimodal sheeted mafic-felsic dike sets are considered feeders to Townsite Flow and Sill, or perhaps Banting Formation lithologies. Late sets of plagioclase porphyritic amphibolite dikes are #8 equivalents



of Henderson and Brown, 1966. These dikes are restricted to the Anton complex and notably absent in the Defeat plutonic suite bodies. Pending U/Pb geochronology, in progress, a 2700+ Ma age is anticipated for the oldest phase of the Anton complex. It is suggested that early phases of the Anton complex were emplaced synvolcanically and late phases were involved in greenstone belt rotation. The Stagg and Awry plutonic suites are subdivided into massive, uncontaminated and strongly deformed inclusion bearing phases and appear to represent late phases of Anton complex. Major zones of extension recorded by deformed mafic dike zones up to 1 km wide in these later phases suggest mafic input and perhaps mafic volcanism outlasted granite emplacement. Synplutonic mafic dikes suggest an intimate relationship between mafic and granitic magmatism. There is strong evidence that a much more extensive supracrustal terrain previously existed west of the present Yellowknife greenstone belt, perhaps through to the Russell Lake greenstone basin. It is not clear whether much of this terrain represents an earlier granitized sub-Kam cycle 1 volcanic episode, collapsed extensions of cycle 2 Yellowknife-type volcanism, or both. Current rift basin and subduction related models for supracrustal evolution at Yellowknife must consider this.

A belt of small plutons exposed along the granite - greenstone contact is petrologically and geochemically similar to the Southeastern Granodiorite and mapped as Defeat plutonic suite. The massive to foliated, tonalitic to granitic plutons intrude Anton complex and a pretitled Yellowknife greenstone belt sequence. The Defeat plutons host molybdenum-bearing granite and quartz vein stockworks possibly related to the younger Duckfish granite. There is increasing evidence for a porphyry style gold mineralization event at Yellowknife. A 2620 Ma age similar to the Southeastern Granodiorite is anticipated for the Defeat rocks, and represents a province wide late magmatic event.

<sup>1</sup> Progress report on geological work in the NWT.

## **A REVIEW OF RECENT MINERAL EXPLORATION AND MINING ACTIVITIES IN THE NORTHWEST TERRITORIES**

Dorothy Atkinson  
NWT Geology Division

Mine development and mineral exploration in the Northwest Territories continue to be robust. Gold remains the preferred target commodity, with the Slave Province the principal area of exploration. Exploration and drilling were reduced in 1989 due to the difficulty of raising venture capital, the adjustment to C.E.I.P. and the land withdrawals in the southern Slave pending the Dene-Métis land claim settlement.

Exploration projects in 1989 at an advanced stage included:

1. George Lake area, Back River Region.
2. Nicholas Lake. Ore reserves are 980,400 t of 12.51 g/t Au.
3. The Sunset Lake area where drilling continues to intersect encouraging stratigraphy within the Beaulieu River volcanic belt. To date, one volcanogenic massive sulphide deposit, the Sunrise, has been proven to contain 2 million t of 8.9% zinc, 4.2% lead, 404.6 g/t silver and 1.029 g/t gold.
4. The Tundra gold deposit where vertical shear zones in felsic volcanics of the Courageous Lake volcanic belt contain estimated ore reserves of 29.5 million t grading 6.857 g/t Au.

The largest gold mine under development in Canada, the Colomac Mine, a 10,000 t/day open pit operation with reserves of 25.4 million t of 1.942 g/t gold, 212 km northwest of Yellowknife will begin production early in 1990. The proposal to mine the Kiggavik deposit, with reserves of 2.99 Mt at 0.61% U<sub>3</sub>O<sub>8</sub>, west of Baker Lake is undergoing environmental assessment and public review.

## **GRAVITY INTERPRETATION OF THE BLATCHFORD LAKE INTRUSIVE COMPLEX<sup>1</sup>**

T. Birkett, D. Sinclair and D. Richardson  
Geological Survey of Canada

A helicopter-supported gravity survey was carried out over the Blatchford Lake Intrusive Complex in September of 1988. Two intersecting gravity lines were studied to allow interpretation of the gross structure of the east and west lobes of this asymmetrical intrusive complex dominated at surface by felsic rocks.

Rock samples were collected at each gravity station and later their densities were measured in triplicate by pycnometer. The gravity model was constrained by the surface geology of the complex determined by Davidson (1978) and by the measured rock densities.

Gravity modelling was carried out in 2 1/2 dimensional space using the MAGRAV2 program of Wells (1979) as modified by Broome (1986). Metasedimentary rocks of the Yellowknife Supergroup were taken as the background rocks for this study, and other rock types were modelled according to their density differences.

The regional background was removed prior to modelling, with the constraint that the background be equal for the two gravity profiles at their point of intersection. The regional gravity background of the western line is influenced by the



metasediments of the Yellowknife Supergroup, and by the large granitic batholiths of Archean age to the west of the Blatchford Lake Intrusive Complex. The regional gravity background of the eastern line is influenced by numerous small granitic intrusive bodies of Archean age in the Yellowknife metasediments. The background in this region is characterized by several domes and basins, and as a consequence a straight-line background in the immediate vicinity (within 15 kilometres) of the complex has been used in this study.

The image of the Blatchford Lake Intrusive Complex provided by the interpretation of this gravity survey is of a thin approximately tabular body emplaced as a series of lobes. These lobes are themselves thin, subcircular intrusive bodies having subhorizontal contacts with the other intrusive rocks of the complex. The lobes can be divided into three classes: the mega-lobe of the Grace Lake granite, second-order lobes of the Thor Lake syenite, and remnant early lobes of the Mad Lake and Hearne Channel granites. Each lobe has been subdivided internally into a number of related intrusive phases. The distribution of the lobes is interpreted to result from the distribution of fracture-controlled deep magmatic feeder systems. These feeder systems, though not reflected in the gravity survey, have been deduced from the distribution of the lobes, and the known fault systems within the intrusive complex. The second-order lobes have a systematic asymmetrical distribution indicative of magma spreading to the west to northwest, probably from a source of limited areal extent.

Intrusion of the magmas which crystallized to form the Blatchford Lake Intrusive Complex continued over a substantial period of time, since dikes of Hearne Channel diabase intruded the complex and are themselves cut by later syenitic phases to the north of Thor Lake. Portions of the Grace Lake granite, therefore, could have been sufficiently cool and rigid to allow ring-fracturing and cauldron subsidence during the emplacement of the eastern lobe of the Thor Syenite.

#### References

- Broome, J., 1986:  
MAGRAV2: an interactive magnetics and gravity modelling program for IBM-compatible microcomputers; Geological Survey of Canada, Open File 1334.
- Davidson, A., 1978:  
The Blatchford Lake Intrusive Suite: an Aphebian plutonic complex in the Slave Province, Northwest Territories; Geological Survey of Canada, Paper 78-1A, p. 119-127.
- Wells, I., 1979:  
MAGRAV users guide - a computer program to create two-dimensional gravity and/or magnetic models; Geological Survey of Canada, Open File 597.
- <sup>1</sup> Contribution to the Canada-NWT Mineral Development Agreement, supported by the Geological Survey of Canada, C 1.2.5.

## REMNANTS OF EARTH'S OLDEST KNOWN CONTINENTAL CRUST, SLAVE PROVINCE, NWT, CANADA

S. A. Bowring  
Washington University  
I.S. Williams and W. Compston  
Australian National University  
F.A. Podosek  
Washington University

The Slave Province contains remnants of the oldest rocks yet discovered on Earth. U-Pb ion probe data (SHRIMP) from two samples of tonalitic gneisses from the western Slave Province indicate that they crystallized at 3.96 Ga. The zircons define a complex array on a Concordia diagram and indicate at least two episodes of Pb-loss and zircon growth. The oldest Pb-Pb ages come from strongly zoned crystals and the average of six nearly concordant analyses is  $3964 \pm 3$  Ma. A population of structurally younger, massive zircons has an average age of  $3621 \pm 6$  Ma. Multiple analyses from individual grains mimic the data set as a whole and spread sub-parallel to Concordia as well as towards a Proterozoic lower intercept suggesting at least two episodes of Pb-loss. The early episode of Pb-loss may correspond to the new zircon growth at 3621 Ma. Conventional single grain zircon analyses yield Pb-Pb ages as old as 3862 Ma.

The same tonalitic gneisses have Nd chondritic model ages as old as 4.1 Ga suggesting that still older rocks may be present in the region and documenting that crust with an enriched Nd isotopic signature was present by 3.8 Ga. This is the first example of a potential enriched complement to the depleted mantle that was already in existence by 3.8 Ga. A major unresolved question is whether Earth's earliest crust was enriched sialic crust that was reworked or whether it was basaltic and subsequently thickened and melted to produce the earliest Archean nuclei. The paucity of crust older than 3.8 Ga favours the latter interpretation.

## GOLD-BEARING IRON FORMATION IN THE WHEELER LAKE BASIN

J. A. Brophy  
Hidden Lake Gold Mines Limited

The Wheeler Lake Basin, situated 100 km north-northwest of Yellowknife, is underlain by metasedimentary rocks of the Yellowknife Supergroup. The basin is a gently arcuate, easterly trending supracrustal belt measuring approximately 10 km by 5 km, and is completely enclosed by granitic intrusions and high-grade gneisses. This is virgin terrain that had neither been staked nor prospected prior to acquisition by Hidden Lake Gold Mines Limited in the autumn of 1988.

The supracrustals have been metamorphosed to amphibolite grade and affected by at least four episodes of deformation. Nevertheless, primary features such as graded bedding, cross-bedding and load structures are well preserved in the thin-bedded, pelite-dominated sedimentary successions that are most common in the basin.

Banded iron formation (BIF) is intercalated with the metasediments, particularly in a 2 km by 8 km belt extending across the centre of the basin. The BIF is generally silicate facies and consists of alternating amphibole-rich and garnet-rich beds. Sulphide-facies iron formation is common, and possibly is most extensive in the vicinity of refolded folds. Sulfides consist of very fine-grained to medium-grained pyrrhotite, arsenopyrite and pyrite.

Approximately 500 samples of BIF collected during the 1989 field season were analyzed for gold. Results were highly anomalous, with at least half the samples carrying more than 100 ppb (and up to 30 ppm) gold. Significant gold showings (>5 ppm Au) associated with sulfide-facies BIF were identified at eight locales scattered across the BIF belt, which is itself only 10-20% exposed. The best continuous chip-sample assays obtained were 9 ppm Au across 3 m at the Carlos Show (west end of property) and 2.7 ppm Au across 7 m at the Marco Show (centre of property).

The BIF has a high density of quartz veins compared to the adjacent metasediments, and the only visible gold observed to date is in a quartz veinlet at the Carlos Show. These observations suggest a link between epigenetic quartz veining and gold mineralization. However, the high gold background in BIF suggests that a syngenetic proto-ore was available for later structural upgrading.

## 1989 EXPLORATION AND MINING ACTIVITY IN YUKON

Trevor Bremner  
INAC Geology Division, Whitehorse

Yukon experienced a sharp drop in mineral exploration in 1989, with expenditures falling to \$18 million from a record high of \$50 million in 1988. Fifteen diamond drill programs were carried out, down more than 50% from the previous year. To the end of September, 1989, the number of claims staked was only 40% of the 1988 figure. However, strong base metal prices encouraged exploration for zinc, nickel, copper and lead. At least 64 separate properties were active, although more than 75% of the exploration dollars were spent by 6 major companies on a few large projects.

Yukon currently has two operating mines, the Curragh Resources Inc. 12,000 tonne/day lead-zinc-silver open pit at Faro and the Canamax Resources Inc. 400 tonne day underground gold mine at Ketzia River. In 1990, declining production from the FARO orebody will be offset by new reserves being developed underground beneath the Faro pit and in new open pits on the Vangorda Plateau.

About six properties are at an advanced stage of exploration. In 1989, pre-feasibility or feasibility studies were released on the 55 million tonne WELLGREEN ultramafic nickel-copper-platinum deposit and two gold-silver vein deposits at MT. NANSEN (576,000 tonnes) and SKUKUM CREEK (465,000 tonnes). Curragh Resources drilled to locate an exploratory shaft on the 21 million tonne DY shale-hosted lead-zinc deposit near Faro and to further define reserves on a 5.2 million tonne high-grade zinc-silver skarn at MT. HUNDERE. At WILLIAMS CREEK Teck Corporation is studying the possibility of leaching a 7.2 million tonne oxide copper deposit.

Other base metal exploration was mostly concentrated in Selwyn Basin. Drilling on the NDU Resources Inc. MARG volcanogenic massive sulphide discovery near Mayo intersected 21.7 m grading 4.5% Zn, 2.6% Pb, 1.43% Cu, 70.8 g/t Ag, and 1.8 g/t Au. Billiton Metals Canada Inc. optioned NDU's BLENDE breccia-hosted zinc-lead-silver occurrence in the same area and traced mineralization intermittently on surface over a strike length of 6 km. Inco Ltd. explored for shale-hosted nickel mineralization on and around the NICK property north of Mayo. Cominco Ltd. drill-tested the west extension of the TOM shale-hosted lead-zinc-silver-barite deposit at MacMillan Pass.

In other areas, First Yukon Silver Resources Inc. discovered mineralization grading up to 28% Zn on the BAR property near Swift River. Trenching exposed two layers of sphalerite associated with pyrrhotite and garnet over a strike length of approximately 90 m. United Keno Hill Mines used a rotary drill to explore new targets around the 6.5 million tonne MINTO granodiorite-hosted copper deposit near Carmacks and Casau Exploration Ltd. drilled stepout holes on the HOPKINS copper skarn near Aishihik Lake.

Exploration for precious metals continued at a reduced level. Diamond drilling was done on Total Energold's O'BRIEN property and Noranda's BREWERY CREEK property near Dawson where gold-bearing veins appear to be associated with high-level Cretaceous intrusions. Mt. Skukum Gold Mining Corp. drill-tested several large veins on the MT. SKUKUM property in the Wheaton River area near Whitehorse. Significant new activity in this area can be expected next year as a result of Placer Dome's agreement to acquire an interest in Skukum Gold Inc. At NDU's HYLAND GOLD property near Watson Lake, rotary drilling is underway to delineate reserves on a large oxide gold deposit.

## STRUCTURAL EVOLUTION OF THE GIANT SHEAR ZONE COMPLEX

Norm Brown  
University of California at Santa Barbara<sup>1</sup>

The Giant shear zone complex in the Yellowknife volcanic belt is an anastomosing system of moderately east-dipping to steeply west-dipping reverse shear zones. Bulk inhomogeneous shortening during the latest phase of deformation produced combinations of pure and simple shear

within the shear zone complex, with maximum elongation occurring along steeply south-dipping trends in the foliation plane. To the east of the West Bay fault, economic grade gold mineralization is mostly restricted to the <500 m wide Giant complex, but anastomosing, reverse shear zones of high strain intensity exist throughout the Kam Group, the overlying Banting Group, and the Jackson Lake Formation. The bulk of this deformation occurred both after crystallization of the Deaf suite of the Western Plutonic Complex and after deposition of the Jackson Lake Formation.

Just south of the Akaitcho fault, where the Giant system attenuates to a single, dominant east-dipping zone, reverse displacements >750 m are recorded by removal of the Townsite Formation from the hanging wall of the shear zone. The position of the Negus variolitic flows to the east of the shear zone indicates that net reverse slip may have removed as much as 2 km from the Kam section.

Gold-related mineralization likely preceded most of the reverse shearing along the shear zones, as evidenced by boudinage, folding, recrystallization, and interleaving of ore zones. Mineralization commenced when earlier generations of high-angle structures within the Kam Group were reactivated as reverse shear zones, under conditions of horizontal maximum compressive stress ( $\sigma_1$ ) and vertical minimum compressive stress ( $\sigma_3$ ). Shear failure along the high-angle structures was accompanied by discrete fluid discharge events. In addition, cycling of fluid pressure and shear stress magnitudes is recorded by mutually cross-cutting flat and steep veins in the central Giant mine. Some ore types are likely recrystallized and deformed flat veins, formed during periods of lithostatic fluid pressure, whereas other areas of boudined, folded, and composite gold-bearing veins probably represent portions of the discharge system. The structures reactivated and mineralized during high-angle reverse shearing were likely dextral or dextral-oblique fault zones, first formed after tilting of the Kam strata.

<sup>1</sup> Research visits in Yellowknife were kindly supported by Giant Yellowknife Mines, Ltd.

#### **REGIONAL ANALYSIS OF JOINTS IN QUARTZ ARENITES OF THE KINGA FORMATION, EARLY PROTEROZOIC HURWITZ GROUP, HAWK HILL-GRIFFIN-MOUNTAIN LAKES AREA, DISTRICT OF KEEWATIN: IMPLICATIONS FOR GOLD<sup>1</sup>**

T.L. Bursey  
Carleton University  
L.B. Aspler  
Ottawa, Ontario

Kinga Formation quartz arenites are intensely jointed and lack a penetrative cleavage, in contrast to basement rocks which shortened by deflection of Archean fabrics, and overlying slates and dolostones which bear a pressure solution cleavage related to E and NE-trending  $D_1$  folds that cross NW-trending  $D_2$  folds. The fold sets represent dome and basin, basement-cover infolding from flexural slip. Joint

orientations are not uniform regionally, but reflect heterogeneous strain of  $D_1$  and  $D_2$  structures. Where  $D_1$  folds are predominant, joint sets are consistent with shortening across  $F_1$  limbs and outer arc extension in hinge zones. Similarly, joint patterns indicate shortening across well-developed  $D_2$  structures. Where both  $D_1$  and  $D_2$  structures are prominent, joint patterns are complex and sets related to both are developed. The fractures are sites of py-asp-cpy-Au mineralization, similar to the past gold-producer near Cullaton Lake; we suggest genetic relationships among folding, jointing and mineralization.

<sup>1</sup> Contribution to the Canada-NWT Mineral Development Agreement supported by the Geological Survey of Canada (Project C 1.2.2.), Indian and Northern Affairs Canada (Yellowknife) and Government of the NWT.

#### **CU-CO-AU-U MINERALIZATION IN MAGNETITE-SPECULARITE MATRIX OF RHYODACITE BRECCIA AT DAMP PROSPECT AND ITS METALLOGENIC SIGNIFICANCE TO THE GREAT BEAR MAGMATIC ZONE<sup>1</sup>**

M. Cannuli, J.A. Climie, M. Sawluk  
Central Electric Generating Board  
S.S. Gandhi  
Geological Survey of Canada

Polymetallic mineralization occurs in a breccia zone within rhyodacite ignimbrite at Damp prospect near Long Tom Lake in the central part of late Aphebian Great Bear magmatic zone. The mineralization is characterized by abundant magnetite-specularite that forms the matrix of the breccia and which carries copper and cobalt sulphides as disseminations and stringers. Gold and uranium values are distributed erratically in the zone. The mineralized zone is over 200 m long, up to 30 m wide, and dips steeply to the south. It straddles the axial zone of an open synform. The gently folded host volcanic sequence is intruded by quartz monzonite and younger granite.

The mineralization is interpreted as the product of volatile-rich fluids generated from the felsic volcano-plutonic complex. This prospect and the similar but larger Sue-Dianne deposit 200 km to the south are regarded as part of the spectrum of deposits that includes magnetite-apatite-actinolite veins which are widely distributed in the Great Bear magmatic zone. In the global context, they relate to the giant Olympic Dam deposit in South Australia, Kiruna deposits in Sweden and deposits in Missouri, U.S.A., all of which are metallogenic signatures of late and post-orogenic, dominantly felsic volcanism in continental platform settings of late Aphebian early Helikian time. Hence the potential for larger deposits of this type in the extensive Great Bear magmatic zone is considered high.

<sup>1</sup> Contribution to Canada-NWT MDA Project C1.2.5 carried by the Geological Survey of Canada.



## **DETAILED AIRBORNE GEOPHYSICAL SURVEYS (GAMMA-MAG-VLF) OF THE LUPIN, THOR AND RELIANCE AREAS NWT<sup>1</sup>**

B.W. Charbonneau, K.L. Ford, S.S. Gandhi  
Geological Survey of Canada

During 1988 five detailed surveys were flown by the GSC Skyvan system in the NWT. Two of these surveys were NWT-MDA related - Lupin (GSC Open File 1921) and Thor Lake (GSC Open File 1922). Reliance (GSC Open File 1988) was flown as a component of the East Arm National Park assessment.

During 1989 field follow-up took place in these areas to obtain specific data - ground geophysics, geology, samples for geochemistry and petrology to enable interpretation of these surveys.

The geophysical surveys effectively map many aspects of the geology as well as point to numerous anomalous features, the explanation of which might help determine the genesis of mineral deposits in these areas.

The principal findings are:

1. At Lupin (Au, Contwoyto Lake) increase in U/Th ratio within the granite adjacent to the mine can be correlated with increase in muscovite/biotite ratio, with the highest ratio granitoids having micas which are almost exclusively muscovite. The high ratio granites are interpreted as being more highly evolved than the low ratio granites. The chemical elements which might accompany this change are being analyzed at present. Results of this work may shed light on whether or not the granite played a part in the gold mineralizing process at Lupin.
2. At Thor Lake (Be - rare metal, Great Slave Lake), ground follow-up concentrated on explaining internal radiometric and magnetic variations within the Grace Lake granite and Thor Lake syenite. No systematic change was noted in bedrock K, U, Th except within the immediate vicinity of the deposit where values increase sharply suggesting the mineralization is a late stage pulse separated somewhat in time from the main crystallization of the Blatchford complex. The mineralized zone itself has thorium and uranium enriched segments.  
  
The most unusual feature in the survey, the anomaly paralleling the East Arm, was verified in bedrock as a pervasive increase in K, U, Th but with no obvious lithological change although sporadic occurrences of a much more radioactive finer grained lithology were noted.
3. At Reliance, between the East Arm of Great Slave Lake and Artillery Lake, numerous discrete U/Th ratio anomalies were found to correlate with a uraniferous garnet-bearing white granite.

The most interesting feature is a thorium-rich (40 ppm) medium-grained to porphyritic granite forming a large circular pluton. The circular body is in the middle of the survey and coincides with a circular magnetic high feature. It occurs at the core of a ring fracture which is marked by a topographic low and has an air photo expression as a semicircle approximately 33 km in diameter. Exposures at a locality in the northern-most part of the ring fracture show brecciated granite with carbonate, quartz, hematite and sericite.

<sup>1</sup> Contribution to the Canada-N.W.T. MDA Project C 1.4.2 carried by the Geological Survey of Canada.

## **GEOCHEMISTRY (TILL, GOSSAN AND LAKE SEDIMENTS - Au AND PGE) AND SURFICIAL GEOLOGY OF THE FERGUSON, YATHKYED AND CONTWOYTO LAKES AREAS, NWT<sup>1</sup>**

W. B. Coker, W. Spirito, R.N.W. DiLabio, and B. Hart,  
Canada-NWT MDA  
Geological Survey of Canada,  
Ottawa.

Reconnaissance and detailed till and gossan geochemical surveys, in the Ferguson, Yathkyed and Contwoyto Lakes areas, and a reconnaissance lake sediment survey, in the Contwoyto Lake area, were undertaken to examine geochemical dispersal patterns and the distribution of gold and associated elements in the till, gossan and lake sediments as related to their application to mineral exploration.

Field checking of an airphoto interpretation of the surficial geology of the Contwoyto Lake area was completed and surficial geology maps prepared. The area flooded by Glacial Lake Contwoyto was estimated by measuring the elevations of raised beaches.

At Ferguson Lake, detailed sampling of gossan and till was carried out around the PGE-bearing nickel-copper sulphide mineralization. Significant levels of platinum and palladium were found in the Ferguson Lake gossan, but there appears to be only limited dispersal of these elements in the till down-ice from the mineralization.

Reconnaissance and detailed till sampling surveys, completed over the gold-bearing metavolcanic belt in the Yathkyed Lake area, outline the gold-bearing units. The newly observed sequence of ice flow directions, related to the Keewatin Ice Divide, in the Yathkyed Lake area suggests that glacial transport from mineralized zones and hence, the details of geochemical patterns, may be complex.

Reconnaissance till and lake sediment geochemical data delineate the gold-bearing units in the Contwoyto Lake area. Detailed till geochemical data reflect the presence of gold mineralization on the six grids examined. Indications are that reworking of till and other surficial sediments in Glacial Lake Contwoyto could effect the results of lake sediment



and soil geochemical surveys by diluting element concentrations or distorting dispersal patterns.

<sup>1</sup> Contribution to the Canada-NWT Mineral Development Agreement, supported by the Geological Survey of Canada, C 1.3.1.

### **THE LARK DEPOSIT: AN ARCHAEOAN VOLCANOGENIC MASSIVE SULPHIDE IN THE BEAULIEU RIVER GREENSTONE BELT**

L. Covello

Covello, Bryan & Associates Ltd.

The Lark Deposit is an Archean age massive sulphide occurrence in the Beaulieu River greenstone belt 110 km east-northeast of Yellowknife N.W.T.

It consists of at least four steeply west-dipping conformable lenses of massive to semi-massive pyrrhotite sphalerite enclosed by intermediate and mafic volcanic rocks. The lenses occur within two distinct stratigraphic positions, and are 120 to 300 m long and up to 14 m thick. Sphalerite occurs as stringer bands and disseminations within chert-pyrrhotite horizons. Pyrite, chalcopyrite and galena stringers and disseminations are accessory sulphides.

The sulphide horizons are flanked to the east by mafic volcanic rocks and to the west by intermediate and felsic volcanic rocks. Whole rock data suggests that the sequence is east facing, based on sodium depletion within andesites immediately to the west of the westernmost sulphide horizon.

The sulphide lenses exhibit a strong horizontal loop electromagnetic response, and a pronounced coincident magnetic signature, both of which served as a basis for initial drill target selection.

### **THE PROGRADE AND RETROGRADE EFFECTS OF KENORAN DIAPIRISM ON THE YELLOWKNIFE GREENSTONE BELT**

N.A. Duke, C.R. Nauman, R.L. Hauser  
and P.D. Strand  
NERCO Con Mine

The Yellowknife Greenstone Belt (YGB) is a steeply dipping southeast facing monocline of spilitic lavas preserved between the Western Granodiorite batholith (WGD) and the eastern Burwash turbidite basin. A moderately to steeply west dipping, variably strained thermal aureole overprints the YGB outward from the WGD. Adjacent to the WGD pillow lavas commonly show aspect ratios of 50-100:1 and are locally transposed into garnetiferous amphibolite band paralleling the intrusive contact. Regionally, amphibolite facies conditions prevail for over a kilometre outward from

the main granodiorite and overprints nearly the whole greenstone belt in the immediate Yellowknife area where granophyric to porphyritic textured apophyses of the WGD intrude the volcanics. Epidote rich calc-silicate bands developed within this thermal aureole parallel intrusive contacts. Steeply plunging breccia pipes occurring along an eastward trending corridor at the NERCO Con Mine include deep level granite-matrixed, intermediate level quartz feldspar porphyry-related and high level gas corrosion breccia types. Breccia textures indicate significant devolatilization coincident with amphibolitization related to intrusive activity.

One of the most enigmatic features of the YGB is the origin of unusually high density of crosscutting dioritic dykes. A number of key structural and petrological indicators suggest these dykes were injected syntectonically with granodiorite emplacement. The dykes are oriented subparallel to the WGD contact, dipping westerly and fanning southwest to northeast from south to north. Actual dyke contacts are often difficult to discern due to merging of chill margins with bordering hornfels textures. Where dykes have intruded calc-silicate bands, the ingested material gives rise to birdseye carbonate-epidote clusters and megacrystic plagioclase trains. The tectonic grain established by these late dykes has a strong control on the orientation of retrogressive shear zones across the YGB. Regionally these NNE trending, steeply to moderately dipping structures focus along dyke swarms, commonly follow dyke contacts, but locally crosscut dykes at low angles. Shear zones show increasing intensity of hydrothermal alteration with development of penetrative foliation. They are interpreted to be related to a dynamic uplift history allowing for isostatic adjustment following granite emplacement.

### **THE METALLOGENIC ASSOCIATION OF GOLD TO GABBRO SILL COMPLEXES IN THE SLAVE PROVINCE**

N.A. Duke, C.R. Nauman and S.R. Newkirk  
NERCO Con Mine

The coincidence of gold camps to domains of gabbro sill emplacement is common across the Slave Province. Sills intrude the mafic to felsic volcanic transition in the westerly Indin Lake Greenstone Belt where amphibolitic gabbro hosts the Kim and Cass gold quartz stockworks on Lex Lake and albitite hosts the bulk tonnage Colomac deposit on Banton Lake. Gabbro sills intrude the basic mafic volcanics in the east facing Courageous Lake Greenstone Belt in the central Slave where overlying felsic pyroclastics interfingering with easterly metasediments hosts the Tundra deposit. Sills also occur marginal to the Bathurst trough within high grade Archean metasediments with numerous iron formation-hosted gold prospects. The gold to gabbro sill association is again well expressed in the Yellowknife Greenstone Belt where known economic gold concentrated in major shear impinging on thick gabbro sills intruding Kam basalts and pyroclastics. Outside the Slave Province prime examples of the

gold/gabbro sill association can be found in the LaRonge Gold Belt, at the Red Lake and Larder Lake gold camps as well as at such world class gold districts as Kalgoorlie in Western Australia.

Although an empirical relation of gold to gabbro sill complexes is evident, this particular metallogenic association is poorly understood. Traditional investigations of gabbro sills have focused on the few, well layered, mafic complexes intruding stable intracratonic settings where magmatic fractionation results in Cr, Ni-PGE, and Fe-V-Ti ores. Hydrothermal processes accompanying multiple sill emplacement into the wet supracrustal sequences of juvenile rift settings are not as well described but lead to major iron oxide and base and precious metal sulphide deposits. Sills intruding active rifts are characteristically thin (10-100 m scale), unlayered, and pervasively hydrated. Quick cooling due to heat loss to convecting fluids prevents crystal fractionation while autohydration obliterates primary mineralogy. Trace element geochemistry indicates that metals liberated during hydration add to the metal inventory of the affiliated hydrothermal fluid. As physical barriers to fluid flow, hydrothermal alteration is focused along sill margins where enhanced fluid/rock reactivity causes metal precipitation. Remobilization of sill margin mineralization is common during post-emplacement metamorphic overprinting as major shears tend to follow sill borders. The common relation of gold-bearing quartz veins to metamorphosed sill complexes indicates that domains of sill emplacement are preferred for gold concentration in metamorphic fluid regimes.

Since the stabilization of cratonic nuclei in the late Archean gabbro sill complexes signify the initial stages of sea floor spreading. The strongly bimodal gabbro sill/felsic pyroclastic rock associations occurring at mafic volcanic platform/sedimentary basin margins plausibly signify similar rift settings which existed prior to cratonization. The sills reflect rejuvenated rifting of older greenstone substrate to initiate basin development. Reactivation of such boundaries during the Kenoran Event could explain many of the enigmatic features shown by Archean structural breaks.

#### **MINERAL RESOURCE COMPILATION OF THE YELLOWKNIFE MINING DISTRICT, NWT, CANADA.**

Hendrik Falck  
GNWT

Canada-NWT Mineral Development Agreement

The 1934 discovery of gold on the east side of Yellowknife Bay sparked concerted exploration in the Yellowknife region which continues today. Since the original discovery, over 400 tonnes (13,000,000 ounces) of gold have been mined from two major and numerous smaller mines, attesting to the mineral wealth of the region.

A large volume of information concerning the geology, structure and nature of gold mineralization has been amassed. Some of this data is readily available to the public through assessment files, government maps and publications, and journal articles. Much more information is stored in the files of mining companies and private individuals. An attempt is being made to compile this information from all sources.

Compilation and classification of mineral showings has outlined five settings presently used as exploration targets:

1. Large anastomosing quartz-carbonate-sericite-chlorite shear zones in mafic Kam Group volcanic rocks.
2. Shear zones with carbonate and sericite alteration haloes in Banting Group felsic volcanic and sedimentary rocks.
3. Mineralized shear zones in early granitoid phases of the Western Plutonic Complex.
4. Early structural, pre-metamorphic quartz veins in greenschist to lower amphibolite grade Burwash Formation turbidite deposits.
5. Strongly foliated iron-sulphide-rich pods in turbiditic sediments.

A better understanding of regional patterns in the Yellowknife District may assist in the discovery of new resources.

#### **THE NATURE OF THE MARGINAL ROCKS OF THE MUSKOKX INTRUSION AND IMPLICATIONS FOR PGE MINERALIZATION'**

Don Francis  
McGill University

As one of the world's major layered intrusions, the Muskox Intrusion of the Northwest Territories is a potentially important host of Platinum Group Element (PGE) reserves. Although 'reef-type' PGE mineralization is present within the main body of the intrusion, low grades have caused interest to shift to the massive sulfides along the footwall of the intrusion. The margin of the Muskox Intrusion comprises an outer olivine-free norite zone which grades inwards to a gabbro-norite zone, and then to an olivine-rich gabbro or picrite.

Within the main body of the intrusion the picrite grades to peridotite and then to dunites of the layered series. In the 'wing' dyke, to the south, the norite zone is a fine grained, massive chilled margin whose width can reach 20 metres while the gabbro-norite zone is a complex magmatic breccia. The width of the marginal zones telescopes towards the north such that at the level of McGregor Lake the norite zone is typically on the order of a metre or less in width and the gabbro-norite zone is massive or exhibits mineralogically layering. Along much of the eastern margin of the intrusion, there are two successive sequences of norite to picrite, preserving evidence for at least two

magmatic pulses. The paragneiss adjacent to the intrusion has melted. Along the 'wing' dyke in the south, a sugary felsite is produced which is rich in disseminated sulphide while the margin of the main body of the intrusion to the north is lined with a plagioclase porphyry or 5 to 15 m of migmatized paragneiss which has been enriched in Mg and depleted in Si. Typically, it is this footwall migmatite which hosts the important sulfide mineralization. In the sulfide-poor rocks of the intrusion, platinum is a compatible element, increasing away from the margin into the intrusion along with iridium and nickel, whereas palladium and gold decrease. Localized sulfide mineralization does, however, occur in the marginal rocks of the intrusion, typically within the gabbro-norite zone along its contacts with both norite and picrite. Elevated levels of Zr and Rb in the marginal rocks indicate that the magmas of the main body of the intrusion were actively digesting country rock. The PGE enrichment along the footwall margin appears to have been produced by reaction between Muskox magmas and partial melts produced from the adjacent host paragneiss.

<sup>1</sup> Contribution to the Canada-NWT Mineral Development Agreement supported by the Geological Survey of Canada, Project C 1.1.6.

#### POTENTIAL FOR OLYMPIC DAM-TYPE Cu-Au-U-Fe DEPOSITS IN THE GREAT BEAR MAGMATIC ZONE

S.S. Gandhi and R.T. Bell  
Geological Survey of Canada

The Olympic Dam deposit in South Australia is a giant Cu-Au-Ag-U-REE-Fe(oxide) deposit hosted by breccia in an anorogenic, felsic volcano-plutonic setting of Helikian age. The Great Bear magmatic zone has the following features favourable for occurrence of large deposits of this type:

- 1) Dominantly felsic volcanic sequences deposited in a late Apehian post-tectonic continental environment.
- 2) Metallogenic signatures of the felsic magmatism in the form of numerous copper, iron(oxide) and uranium occurrences.

Examples of the Olympic Dam-type deposits in the magmatic zone are the Sue-Dianne deposit (8 million tonnes; 0.8 % Cu; some Au and U), and Mar and Damp prospects, in rhyodacite ignimbrite breccias with magnetite-specularite matrix. The magmatic zone also hosts many magnetite-apatite-actinolite veins that are comparable to the much larger iron deposits of the Kiruna and Bergslagen districts in Sweden and in the St. Francois Mountains of Missouri. These iron deposits of late Apehian and Helikian age have been interpreted as variants of the Olympic Dam deposit.

#### THE GEOLOGY OF THE HOPE BAY AND ELU INLET METAVOLCANIC BELTS NORTHEASTERN SLAVE PROVINCE, NWT

James Gebert  
GNWT

Canada-NWT Mineral Development Agreement

The Archean Hope Bay (76 O/9, 10, 15, 16; 77 A/3, 6) and Elu Inlet (77 A/2, 7, 10) metavolcanic belts are in the northeastern corner of the Bathurst block of the Slave Province (Figure 1). During 1989 the central portions of the Hope Bay (76 O/15, 16) and Elu Inlet (77 A/2) belts were mapped at a scale of 1: 50,000.

##### Hope Bay Metavolcanic Belt

Mafic to intermediate volcanic rocks, pillowed and massive flows, are the most common lithologies. Pillowed flows are commonly variolitic, although varioles are obscured by deformation and alteration in the southern portion of the belt. Alteration and metamorphism of lavas makes field separation of basalt and andesite difficult if not impossible.

Primary felsic volcanic flows are uncommon in the Hope Bay belt. Common felsic volcanic rocks include tuff, lapilli tuff, volcanoclastics and conglomerates with volcanic clasts. Volcanoclastic rocks can be further sub-divided on the presence or absence of feldspar crystals in the matrix.

Sedimentary rocks occur as thin interflow shale lenses within pillowed mafic volcanics and as thicker interbedded units of sandstone, siltstone and shale that resemble turbidites. Thin lenses of silicate-facies iron formation are intercalated with pillowed flows in the northern portion of the belt.

Gabbro, leucogabbro and diorite intrude the supracrustal rocks of the Hope Bay belt. Felsic intrusions of quartz-feldspar porphyry and feldspar porphyry are less common. Ultramafic sills occur along the length of the belt although thicker sills are confined to the northern portion of the belt.

Granite to granodiorite borders the belt to the northeast and west. Granitoids often display the regional north-trending foliation in the northeast portion of the belt, but are generally non-foliated in the west. The southeastern portion of the belt is bordered by a heterogeneous terrane that includes gneiss, paragneiss, foliated and non-foliated granitoids and lenses of amphibolite.

A gently dipping conglomerate composed of rounded, unstrained granitic cobbles and of supracrustal rocks derived from the Hope Bay belt crops out in Hope Bay at the northern end of the belt. This conglomerate unconformably overlies vertically dipping mafic volcanic rocks and is the youngest preserved supracrustal rock of the belt.

The Archean rocks of the Hope Bay belt are unconformably overlain by Apehian and Helikian sedimentary rocks at the northern end of the belt. Hadrynian diabase dykes and sills transect all older lithologies.



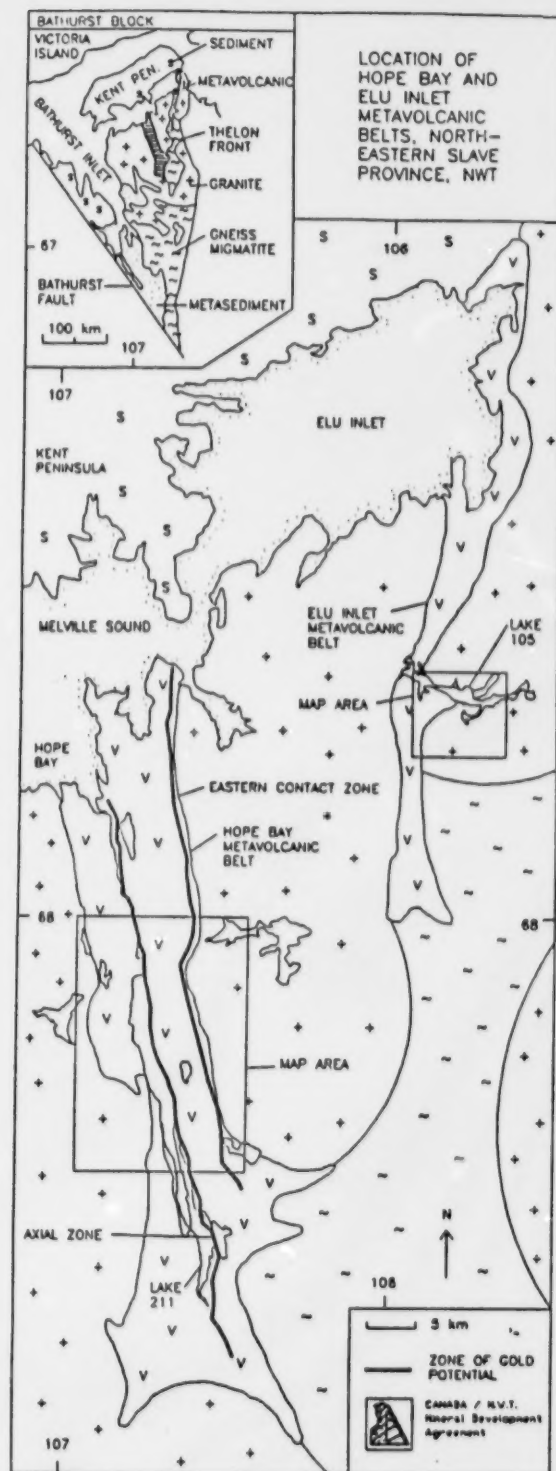


Figure 1: Geology of the Hope Bay and Elu Inlet.

The Hope Bay belt is characterized by a strong, subvertical regional foliation parallel to the contacts of the belt. In sedimentary rocks it is preserved as an earlier bedding parallel foliation, overprinted by a later northeast-trending foliation. This later fabric may be represented in the metavolcanics by a northeast-trending fracture set. Pillow lavas have been flattened in the foliation plane and are elongated in a vertical direction. Preserved pillow topping directions indicate a north-trending anticline underlies the medial axis of the belt. Structural repetition by further isoclinal folding or faulting is probable. Less deformed lavas of the northern Hope Bay belt indicate the eastern limb of the anticline is overturned. Intense shearing, subparallel to the regional foliation is accompanied by silicic, chloritic and carbonate alteration that overprints pre-existing fabrics. Particularly intense carbonate alteration is associated with a shear zone close to, or coincident with the antinodal fold axis of the belt. The metamorphic grade of the belt increases from greenschist to amphibolite facies towards the granitoid terranes. Granitoid dykes cut the amphibolite-facies zone. Late quartz-carbonate veins, commonly with chloritic vein margins, cut the carbonate-altered shear zones and also the amphibolitic margins of the belt.

#### Elu Inlet Metavolcanic Belt

The Elu Inlet belt is more highly deformed and metamorphosed than the Hope Bay belt, but appears to have been originally composed of similar lithologies. Pillowed mafic volcanics, felsic volcanics, metasedimentary rocks, mafic and ultramafic intrusions have all been recognized despite amphibolite-facies metamorphism. The Elu Inlet belt appears to have experienced a phase of deformation not recognized in the Hope Bay belt. In the vicinity of Lake 105 the strong north-trending regional foliation is folded about a northwest-trending axis. Granitoid country rocks, with a north-trending regional foliation are cut by northwest-trending pegmatite dykes.

#### Economic Potential

The Hope Bay belt has the potential for vein silver, base metal and gold deposits. Within the Hope Bay belt two zones of gold potential have been recognized (Figure 1). The axial zone consists of a large carbonate-altered shear zone that is locally crosscut by auriferous quartz-carbonate veins. The eastern contact zone hosts a series of auriferous quartz-carbonate veins that cut the amphibolitic margin of the belt.

Many gossan zones containing pyrite, pyrrhotite and chalcopyrite were noted in the Elu Inlet belt. This belt may have potential for gold as many of the gold showings of the Hope Bay belt occur within amphibolite-facies mafic volcanic rocks. The Elu Inlet belt also has the potential for Cu-Mo mineralization as a small pegmatite hosted Cu-Mo showing occurs along the western contact of the belt.



## PRELIMINARY GEOLOGIC INTERPRETATION OF SAR DATA YELLOWKNIFE-HEARNE LAKE AREA, NWT

W.A. Gibbins, C.E. Ellis  
NWT Geology Division  
V.R. Slaney  
Geological Survey of Canada

Wide swath, C band SAR (Synthetic aperture radar) data, obtained from the Yellowknife-Hearne Lake area, essentially reflects the geomorphology or landforms of the region. These in turn can be readily related to specific lithologies, rock masses, structure, cultural features, etc.

Textural and tonal (brightness) characteristics of the radar images can be used with drainage and lakeshore characteristics to define or map several lithologic types. Granite terrain, generally the brightest (lightest) area, has a 'coarse' mottled signature reflecting the hummocky surface characteristic of granites in this area. Circular structures, related to shape and/or multiple intrusion, as well as lineated structures, related to glaciation and/or regional tectonics, are displayed. Metasedimentary terrain is typified by an intermediate tone, a thin laminated texture reflecting bedding, and angular shore lines of some lakes. Irregular and tight fold patterns are obvious for much of this terrain. Metavolcanic terrain is subordinate in area and well defined textural or tonal characteristics. It is most easily recognized as 'coarsely' spaced ridges with little or no curvature possibly reflecting intercalated metagabbro sills or massive flows.

Undifferentiated bedrock includes those areas where characteristics are not developed or recognizable at the scale and resolution of the imagery. The Yellowknife Hearne Lake area contains few thick or extensive surficial deposits and aside from some large swampy areas is mainly outcrop.

The city of Yellowknife is readily identifiable by its bright signature and rectangular pattern or texture. Smooth, horizontal surfaces, such as lakes, runways and roads, are black because all of the energy is reflected away from the radar antenna.

Lineaments, recognized by the alignment of rivers and shorelines, are greatly enhanced by the radar reflections off cliffs, and shadows of intervening valleys. Several major structural lineaments in the area, known from aeromagnetic and geological maps (diabase dykes, faulted contacts, etc.) are readily apparent in the SAR imagery, as are numerous extensions and subsidiary lineaments.

Unexplained lineaments, readily observable on SAR images, include radial, curvilinear lineaments in the Western Plutonic Complex southwest of Yellowknife and concentric and radial features in some of the many granitic stocks of the Hearne Lake area.

## PRELIMINARY REPORT ON THE NORTHERN PART OF THE ELU INLET VOLCANIC BELT

Walter A. Gibbins  
NWT Geology Division

The Elu Inlet Volcanic Belt is a north trending Archean greenstone terrane, 80 km long and 5 to 10 km wide, in the northeast corner of the Slave Structural Province. The northern part of this belt lies along the eastern shore of Elu Inlet, on the Arctic Coast.

The belt is dominated by a synform of andesite to rhyodacite, including massive and pillowed flows, pillow breccia and minor chert-jasper exhalite. Massive medium to coarse grained gabbros form the most mafic rocks of the belt. They are cut by related porphyritic dykes with dark green pyroxene and/or white feldspar phenocrysts. Epidote is ubiquitous and glomeroporphyritic meta-gabbros and andesites are common. Pillow lavas locally show flattening in a north-trending vertical plane or near vertical stretching. There are numerous shear zones with well developed slaty cleavage. The most prominent lies near the axis of the belt and corresponds to the east side of a prominent peninsula in Elu Inlet and the valley wall of a small river that flows into the south end of Elu Inlet.

Rare feldspar porphyry intrudes the greenstones but is relatively undeformed. Near the margins of the volcanic belt aphanitic, bright-red, silicious felsite/aplite dykes are common. Pegmatite dykes are also present and related to younger granitic intrusions.

Proterozoic quartzite and diabase sills cover part of the northern end of the belt. Quaternary beach gravels are locally well developed, and outcrop is generally greater than 50 per cent.

Sulphides are most evident as impressive surface gossans. Northerly trending gossan zones lie in the center and eastern parts of the area. They appear to be controlled by stratigraphy, but structure may also be important. Locally excellent box work texture is developed. Pyrite is the main sulfide mineral. Sulphides are also found in quartz veins, often with pyrite filling the center of the vein. Minor chalcocopyrite and secondary malachite are found in some veins.

## GEOLOGY OF THE PISTOL BAY - MISTAKE BAY AREA: KAMINAK GREENSTONE BELT

S.P. Goff  
GNWT  
Canada-NWT Mineral Development Agreement

A section across the northeast end of the Kaminak greenstone belt was largely mapped at a scale of 1:30,000, in 1988 (55K/7 and 10, 2NE, 11E and parts of 6 and 9), and completed in 1989 (55K/7SW, 2, 8 and 9S). This area is underlain by the Archean Kaminak Group which here

comprises two mafic- metavolcanic and two metasedimentary units. These units are described in order from south to north.

- 1) A west-facing metavolcanic unit at Whale Cove is composed predominantly of plagioclase porphyritic to variolitic pillow basalts, intravolcanic mafic sills, pillow breccia, minor felsic volcanics and stocks of intrusive gabbro and porphyritic diorite. Intravolcanic beds of chert and chert- amphibole- magnetite, less than 5 m thick may contain minor pyrite. Further west, in Mistake Bay, the upper part of this sequence is composed of pillow basalts with minor rhyolite domes followed by thin bedded agglomerate to lapilli tuff.

Morso Island, to the south, is a subvolcanic complex of aphyric to porphyritic mafic sills and gabbro- diorite sheets.

Pork peninsula, to the northeast, is included in this unit. It comprises a north- facing sequence of pillow basalt, mafic intravolcanic sills and minor porphyritic diorite sheets. Intravolcanic beds of quartz- chlorite or black shale are less than 5 m thick and may contain pyrrhotite and chalcopyrite. Beds of chert- magnetite, chert- dolomite- quartz and pyrite- dolomite may occur in composite zones, one of which is over 20 m thick. Below this sequence is a south- dipping complex of massive to pillowed basalt and gabbro- diorite sills.

- 2) A southwest- dipping homoclinal sequence of turbiditic metasediments comprises two main lithologies: a repetitive sequence of graded feldspathic arenite, wacke, siltstone and slate with rip-up clasts, intraformational conglomerate and chert- magnetite bands, plus a thickly- bedded massive feldspathic arenite member. Chert- magnetite bands, mafic volcanic flows and felsic agglomerates occur in the middle part of the sequence which is intruded by gabbro plugs. To the west, across Wilson Bay, the upper part of the unit shows a similar turbidite sequence with minor basalts.
- 3) A belt of west to southwest- facing, mafic metavolcanic flows occurs north of Pistol Bay. This is predominantly pillowed with subsidiary massive flows and minor variolitic massive flows. Subvolcanic lenticular domes of rhyodacite are common. Intravolcanic beds of quartz- magnetite and of chert may occur with sulphides, displaying pyrite and pyrite- pyrrhotite respectively.
- 4) A northeasterly- trending belt of schists shows fine-scale interlayering of quartzo- feldspathic and garnet- biotite schists, suggesting medium- grade metamorphism of a turbidite sequence. This sequence contains numerous thin magnetite bands and differs from that at Wilson Bay.

Porphyritic biotite- adamellite to biotite- hornblende granodiorite plutons intrude the mafic units. Regional metamorphism reached greenschist facies just west of Pistol

Bay, however, higher- temperature albite- epidote- amphibolite facies was reached in East Pistol Bay and further south, at Whale Cove. North of Pistol Bay, amphibolite facies occur and the granitoid plutons become increasingly sheared and foliated, eventually forming a migmatite zone with biotite- quartz gneiss.

In the Whale Cove and Mistake Bay area, north striking shear zones are associated with dolomitization whereas an 050° striking fracture set is host to quartz- chalcopyrite veins. On Pork Peninsula, an 080° striking, vertically dipping ductile shear set strikes parallel to bedding is associated with chlorite- quartz- dolomite and is cut by a later 150° striking, easterly dipping dextral ductile shear set. In the Pistol Bay area, at least three phases of brittle to ductile shear occur: S1 - a 155° striking, westerly dipping, bedding parallel set shows both sinistral and dextral offsets and is accompanied by the injection of narrow biotite granite veins; S2a - a less pervasive 060° striking, sinistral set cuts the granitoid intrusions and is accompanied by aplite injection; and, S2b - a major 085° striking, north dipping, post granitoid, sinistral set. all sets, notably S2b, are associated with quartz- dolomite veining and dolomite replacement of host metabasalt. Pyrite and chalcopyrite can occur in these veins.

Gold assays of greater than 1 g/metric ton were obtained from: (1) an 8 cm northerly trending pyrite- chalcopyrite quartz vein at the basalt- granitoid contact in unit 1; (2) pyrite- arsenopyrite- chalcopyrite disseminations in a gabbro stock in unit 2; (3) pyrite- chalcopyrite- magnetite beds and associated northeasterly shear in minor pillow basalts at the base of unit 2; (4) S1 fracture cleavage with pyrite in a gabbro of unit 3; (5) pyrite- quartz dolomite from an S2a vein in unit 3; and (6) pyrite- quartz from a 1 m, northeast striking vein in unit 4.

## GEOLOGICAL RELATIONSHIPS IN THE NORTHERN PART OF THE YELLOWKNIFE GREENSTONE BELT

H. Helmstaedt  
Department of Geological Sciences  
Queen's University

Field work during the 1989 season in the northern part of the Yellowknife greenstone belt confirmed that deformed granitoid rocks of the Anton complex (Henderson, 1985, GSC Memoir 414) at Dwyer Lake are intrusive into an assemblage of quartz arenites, felsic volcanics, and banded iron formation that is in conformable contact with pillowed flows of the Chan Formation of the Kam Group. A large block of the iron formation forms a xenolith in the deformed granite directly to the north of the northeastern arm of Dwyer Lake, and a number of xenoliths of quartz arenite were found in the granite at the southwestern shore of this lake. The intrusive contact with fuchsite-bearing quartz arenites are exposed approximately 100 m south of the southwest corner of the lake, and a sheet of Anton granite has intruded between arenites and felsic volcanics approximately 100 m to the east of the main intrusive granite body.

Described as possible sub-Kam Group deposits by Helmstaedt et al. (1986, Canadian Journal of Earth Science 23, 454-475), the quartz arenite-felsic volcanic-iron formation assemblage has been referred to informally as Likely Formation by Padgham (1987, Field Guide YK Mining District), though the term Dwyer Formation would be preferable, as it outcrops only in the vicinity of Dwyer Lake. Although not directly associated with ultramafic rocks, this sub-Kam Group assemblage may represent a remnant of a quartz arenite-ultramafite association such as that identified recently at Beniah Lake by Covello et al. (1988, GSC Paper 88-1C, 223-232). The chromium in the fuchsita mica of the Dwyer Lake quartz arenite appears to have been derived from detrital chrome spinels, suggesting that ultramafic rocks must have existed within the provenance area of the arenites. The age of the Dwyer Lake assemblage is still uncertain. However, as detrital zircons of more than 3.0 Ga have been identified in the arenites (C. Isachsen, personal communication, 1989), the influence of a pre-Yellowknife Supergroup continental basement is also indicated.

The rocks of the Dwyer Lake assemblage are intruded by mafic dykes and sills, remnants of which also occur as amphibolite xenoliths in the Anton granite, and by later mafic dykes that also cut the Chan Formation and Anton granite but predate the Duckfish Lake granite. These later dykes resemble those of the post-volcanic but pre-Western Granodiorite mafic dyke swarms that cut the Kam Group in the Yellowknife area.

Stratigraphic facing within the Dwyer Lake assemblage is unknown, but pillows in the adjacent Chan Formation young to the southeast, suggesting that the pillowed flows overlie the banded iron formation. Where exposed, north of McKay Lake, the contact between iron formation and the first mafic flow of the Chan Formation is intruded by an approximately 10 m wide mafic sill, but no signs of faulting have been seen on either contact of this sill. Considering that the Anton granite has intrusive contacts with the supracrustal rocks of the Dwyer Lake assemblage, and that field evidence for thrusting between this assemblage and overlying pillowed flows of the Kam Group is lacking, the notion of the Anton granite representing a "basement complex" to the supracrustal rocks of the Yellowknife Supergroup (Henderson, 1985, GSC Memoir 414), or a "basement terrane" in thrust contact with the Yellowknife Supergroup (Kusky, 1989, *Geology*, 17, 63-67) should be abandoned.

The lack of interflow sedimentary rocks and the abundance of dykes and sills in the Chan Formation of the Kam Group are consistent with rapid spreading in a marginal basin setting; the Dwyer Lake assemblage representing remnants of a sialic basin floor. Although the dimensions attained by this basin will remain unclear, the thickness of the mafic section makes it almost certain that the width of a narrow intracontinental rift was exceeded. The first interflow sedimentary rocks appear in the Crestaurum Formation, but these are cherts and tuffs which evidently lack detritus derived from an older basement (i.e., zircons with basement ages have not yet been found). The dyke complex in the Chan Formation is best exposed in the vicinity of Oro Lake and between this lake and Ano Lake. Geochemists

sampling this dyke complex should be aware that the early dykes (which show mainly northwesterly-striking chilled margins) are cut by numerous later dykes (with more northerly and northeasterly strikes) which resemble the post-volcanic, pre-Western Granodiorite mafic dykes elsewhere in the belt.

## MINING TRAINING IN THE N.W.T.

Tom Hoefler  
Mining Training Coordinator  
Arctic College

The mining and exploration industries have identified a need for training in the north. Too few northerners have the skills and education to secure more than entry level employment in the industry. As a result, industry has been forced to employ northerners as labourers.

Arctic College is the training agency of the Northwest Territories. It has been given the mandate to provide educational services to adult northerners for employment in the northern workforce. It is the logical choice to provide mining training.

Through research of the mining job market, through discussions with various training organizations in the country, and through consultation with several chambers of mines, Arctic College has developed a mining strategy for the Northwest Territories. The mining strategy recommends training begin in two areas within mining and exploration.

Northern mines have indicated that pre-employment and mill operator training will be of value to their operations. Pre-employment training will provide students with the basic education and training to enter any area of the mining work force. Mill operator training will prepare students specifically for work in mine mills. Both programs will provide students with instruction in first aid, safety, and life skills.

The N.W.T. Chamber of Mines currently is polling its members to establish the demand for exploration training. Initial response indicates that prospector and geophysical operator training will be of most value. Prospector training will include instruction in basic geology, camp construction, staking, gridding, and map and air photo use. Trenching methods will be taught, and students will receive a blasting certificate. The geophysical operator course will build on skills learned in the prospector course. Students will be taught how to conduct the more common geophysical surveys - VLF and Max-Min EM, magnetic, and gravity. Instruction will be given on both analog and digital instruments, with instruction on data dumping to computer given with the latter. First aid and safety will be integral to both courses. It has been proposed to teach both courses in the field on existing claims.

Arctic College is open to requests from industry or individuals for a variety of training. Suggestions to date include short courses in remote sensing and GIS systems, blasting, geophysical instrument operation, diamond drilling, and helicopter safety. Arctic College will not hesitate to develop and provide training in any area, if demand warrants it.



**U-Pb ZIRCON GEOCHRONOLOGY OF THE  
YELLOWKNIFE VOLCANIC BELT, NWT  
CONSTRAINTS ON TIMING AND  
DURATION OF GREENSTONE BELT  
MAGMATISM AND DEFORMATION**

C.E. Isachsen and S.A. Bowring  
Washington University of St. Louis

The Yellowknife volcanic belt in the southern Slave Province has long been considered an archetypal Archean greenstone belt, offset by anastomosing Proterozoic strike-slip faults. Stratigraphic analysis and palinspastic restoration based on lithologic correlation of certain distinctive units within the homoclinal belt has been applied by various workers to suggest lateral continuity and stratigraphic coherence of the volcanic sequence. A cornerstone of the proposed stratigraphy is represented by the three dissociated segments of rhyodacite to dacite tuffs, breccias, and pillowed flows comprising the Townsite Formation within the otherwise dominantly tholeiitic Kam Group.

In order to test the lithologic correlations, zircon separates were obtained from the three segments of the Townsite Formation for U-Pb analysis. Upper intercept ages of  $2683 \pm 5$  Ma,  $2703 \pm 2$  Ma, and  $2705 \pm 3$  Ma for the three segments show that they are not all correlative. These data have strong implications concerning the location of roughly bedding-parallel gold-bearing shear zones which failed to correlate with previous restorations.

Age determinations for smaller felsic tuff beds from the Kam Group range in age from  $2688 \pm 3$  Ma to  $2716 \pm 9$  Ma (the oldest date yet reported for supracrustal rocks in the Slave Province). Basal intermediate to felsic volcanics of the overlying Banting Group yield an age of  $2670 \pm 14$  Ma indicating a protracted magmatic history for the belt spanning more than 45 m.y. A similar age of  $2676 \pm 19$  for a dike of quartz-feldspar porphyry which intrudes the Kam Group suggests it is one of many feeder dikes to the Banting Group and pins the deposition of the Banting Group on the Kam following a significant erosional interval.

An age of  $2609 \pm 6$  Ma has been determined for a granitic cobble extracted from conglomerate of the Jackson Lake Formation (JLF). Moderate to strong elongation of clasts within this unit therefore represents a late deformational event. It is suggested that the JLF is a sedimentary response to late tectonic uplift and compression in the belt and may represent the remnants of a foreland basin sequence.

Preliminary ages for rocks from the Likely Formation, a thin succession of metamorphosed quartzite, rhyolite, and banded iron formation which occurs beneath the Kam Group will also be presented. Ages in excess of 3.0 Ga for detrital zircons from the quartzite have been determined, further supporting the nearly-erased evidence for older basement in the region.

A tectonic model is proposed wherein the Banting Group represents an arc terrane superposed unconformably on older, primitive arc and/or marginal basin volcanics of the Kam Group, and imbricated along with meta-turbidites of the Duncan Lake Group during a late compressional event.

**GEOLOGY OF THE WILLINGHAM LAKE  
VOLCANIC BELT  
SOUTHERN KATHAWACHAGA LAKE MAP AREA  
(NTS 76L)**

by V.A. Jackson  
NWT Geology Division

During 1989 the third season of field work in the Kathawachaga Lake map area was completed. Previous work was concentrated on the southern extension of the High Lake Volcanic Belt in the northern area. This season mapping was concentrated in the southern part of the area, mainly in the Willingham Lake volcanic belt (WLVB).

WLVB lies immediately north of the northern tip of Contwoyto Lake (Figure 1), in the west-central Slave Province. Although somewhat irregular in outline, the main part of the belt has a pronounced arcuate shape, concave to the northwest. Preliminary examination indicates most of WLVB supracrustals are metamorphosed to amphibolite grade but gneissic (high grade) equivalents occur in eastern and southern parts of the belt. WLVB is bounded and disrupted by a variety of granitoid intrusions. South of Kathawachaga Lake, Proterozoic strata of the Goulburn Group and diabase sills overlie the Archean. Quaternary deposits blanket a significant portion of the area.

Mafic-intermediate volcanic rocks are primarily pillowed and massive basaltic to andesitic flows with minor amounts of intercalated pillow breccia and pyroclastics. Felsic-intermediate volcanic rocks are predominantly pyroclastic, ranging from lapilli tuffs to breccias. Felsic lava flows are rare. Banded amphibolite to hornblende gneiss represent the high grade equivalents of mafic volcanics and felsic-intermediate pyroclastics. In the northern part of WLVB, highly strained and altered volcanics form a NE-trending zone about 200-500 m wide and 13 km in length. Deformation within this zone was accompanied by quartz, carbonate, chlorite and sericite alteration.

Sedimentary rocks form a small part of WLVB. Conglomerate, containing volcanic and less abundant sandstone clasts, locally overlies and interfingers with the volcanic sequence. Pelitic sedimentary rocks are locally associated with banded magnetite iron formation, garnet amphibolite (+/-sulfide) iron formation and calcareous sedimentary rocks. Enclaves of pelitic sedimentary rocks are abundant within the granitoid terrane south of WLVB. South and east of WLVB metasediments comprise a paragneiss unit, which has been derived, in part, through injection of tonalitic material.



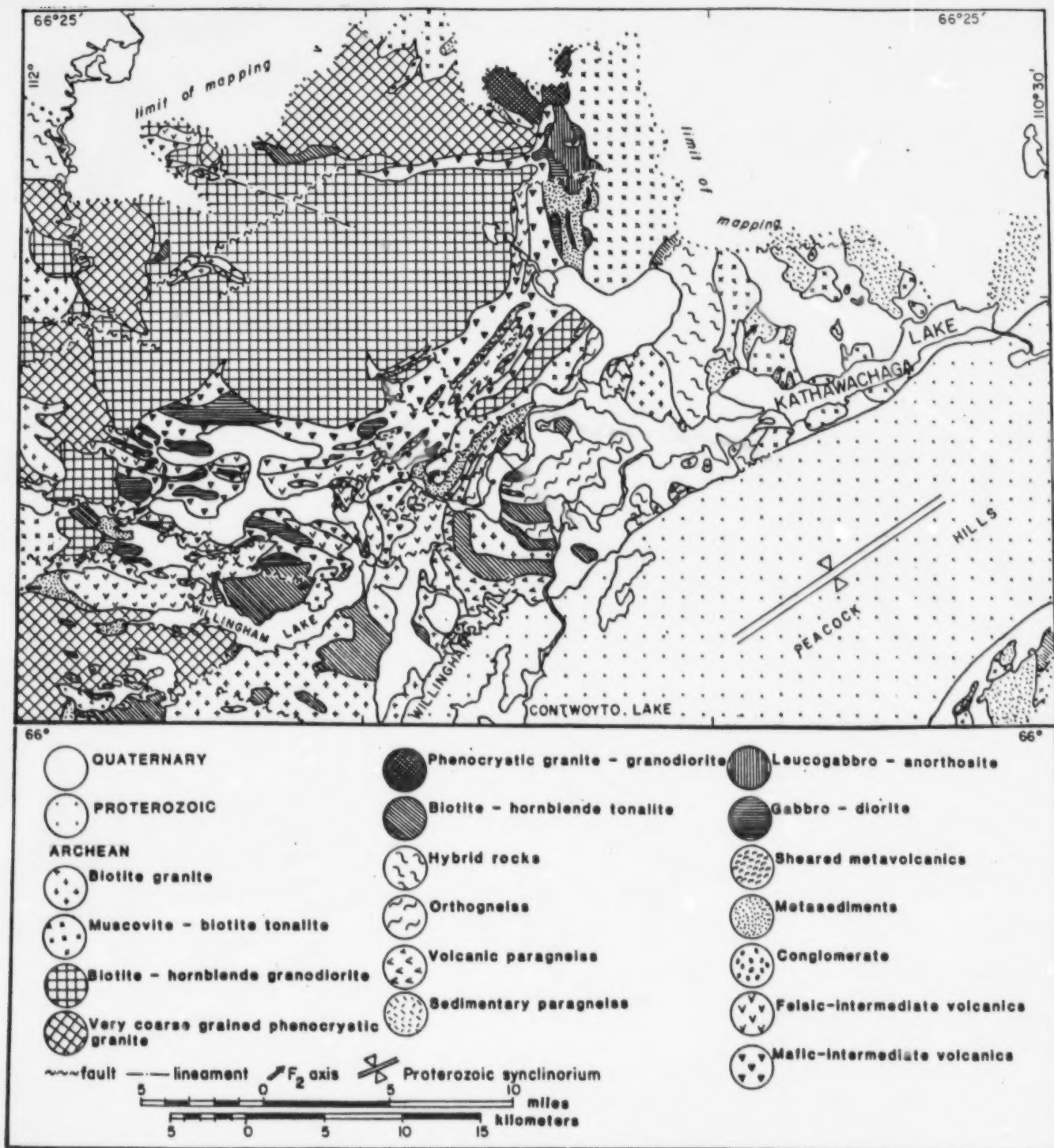


Figure 1: General Geology of Willingham Lake Volcanic Belt

Gabbro, leucogabbro and diorite, the earliest phase of intrusion, cut the supracrustals but not the bounding granitoids and show a similar tectonometamorphic history as

the supracrustals. An ilmenite-bearing leucogabbro to anorthosite in the northern part of WLVB may be associated with these mafic intrusives. Younger granitoid intrusions

include, in approximate order of intrusion: a) strongly foliated biotite +/- hornblende tonalite to granodiorite; b) feldspar porphyritic biotite +/- hornblende granite-granodiorite; c) very coarse grained to megacrystic feldspar porphyritic granite-granodiorite; d) biotite +/- hornblende granodiorite-granite, which is commonly quartz porphyritic but is also compositionally variable and includes quartz monzodiorite, monzodiorite and diorite; e) muscovite-biotite +/- apatite and tourmaline granodiorite-tonalite, which is associated with white pegmatite and contains abundant supracrustal xenoliths and; f) massive to locally foliated, equigranular to feldspar porphyritic, biotite +/- muscovite granite associated with pink pegmatite. These are defined on the basis of mineralogical and textural criteria as well as cross-cutting relationships and the preservation of successively developed fabrics. Mixing of two or more intrusive phases has produced hybrid rocks, which may display migmatitic, including agmatitic textures. Hybrid rocks, typically found between plutons, consist of variable proportions of the two intrusive phases. In the southeast, biotite +/- hornblende granite-tonalite orthogneiss is intruded by pegmatite, but relationships to other intrusive phases have not been precisely established.

Two major fold sets (F1, F2), associated with axial plane cleavages (S1, S2), are documented mainly through structures preserved within the pelitic metasediments and paragneissic equivalents. In the west, F1 minor folds are isoclinal and vary from upright to steeply plunging. These are refolded about WNW F2 isoclinal folds that are associated with a vertical to NNE-dipping S2 axial planar cleavage. In the eastern area, large scale NE-plunging folds (F2?) refold small scale folds (F1?), a pre-existing fabric (foliation and gneissic layering) and are associated with a vertical to NW-dipping S2 axial plane cleavage. Thus both S2 and the axial trace of F2 folds may conform to the arcuate shape of WLVB. Locally, S2 contains a pronounced linear fabric, defined by the elongation of both primary structures and metamorphic minerals (mainly amphiboles). NE-trending asymmetric minor folds may correspond to F2 or later cross-folding related to cleavage forming events (F3?). In pelitic paragneiss F4(?) resulted in the development of crenulations and open symmetrical to chevron folds of gneissic layering about NW-trending axial planes. Relations between NE and NW fold sets are uncertain.

Proterozoic deformation was largely restricted to faulting and led to the development of NE and NW trending conjugate faults. Brittle deformation is most common in these fault zones, but some NE-trending faults contain a mylonitic fabric. Evidence of Proterozoic folding of Archean lithologies has not been precisely established, but such folding is inferred to have affected the Archean in the southeastern area, adjacent to the Proterozoic Peacock Hills synclinorium.

Potential economic targets in the area include:

1) thin, sulfide-bearing interbedded chert and graphitic schist units within the volcanic sequence, possibly an exhalite, one sample of which assayed 1.5 ppm Au and 1.3 ppm Ag;

2) the zone of highly strained and altered volcanics, which incorporates some sulfide-bearing layers;

3) small shear zones within predominantly felsic-intermediate volcanics marked by rusty sericite schist are locally arsenopyrite-bearing;

4) banded magnetite iron formation and associated lenses of massive pyrite, sphalerite, chalcopyrite and pyrrhotite;

5) pyrrhotite-rich zones within mafic volcanics and associated mafic intrusions;

6) the ilmenite- and locally sulfide-bearing anorthositic gabbro intrusion.

#### THE CAMERON RIVER METAVOLCANIC BELT AND THE SLEEPY DRAGON COMPLEX IN THE FENTON LAKE AND BROWN LAKE AREAS, SLAVE PROVINCE: STRATIGRAPHY AND STRUCTURAL RELATIONSHIPS<sup>1</sup>

Donald T. James  
Shield Research Canada

1:50,000-scale mapping in 1988 and 1989 has revealed that between Fenton Lake and Brown Lake, Archean rocks may be subdivided into four lithologic - structural domains. The domains consist of granitoid gneisses and meta-plutonic rocks of the Sleepy Dragon Complex, metavolcanic rocks of the Cameron River belt, metamorphosed greywacke - mudstone turbidites of the Burwash Formation, and unmetamorphosed granite. The Burwash Formation domain also includes a thin belt of metavolcanic rocks that occurs west of Van Lake.

The Cameron River metavolcanic belt is composed dominantly of pillow and pillow breccia mafic volcanic rocks with lesser amounts of meta-gabbro dykes/sills. Ultramafic rocks are rare. Thin meta-rhyolite units occur both in the middle of the volcanic succession at Fenton Lake, and sporadically along the contact between the Cameron River belt and the Burwash Formation. A 2 km<sup>2</sup> rhyolite dome occurs 1 km southeast of Van Lake. The belt also contains several occurrences of iron formation. The most extensive occurrence is at Brown Lake where banded chert-magnetite iron formation is exposed somewhat discontinuously for 4 km along the contact between the Cameron River belt and the Sleepy Dragon Complex. A zone of chert-magnetite iron formation, garnet-amphibolite rocks and sulphide-stained zones occurs within the metavolcanic belt approximately 400 m west of Brown Lake.

The contact zone between the Cameron River belt and the Sleepy Dragon and granite domains is variably strained. Commonly the contact zone is marked by protomylonitic and mylonitic rocks with westerly dips and steeply-oblique to down-dip mineral elongation lineations. Kinematic indicators

suggest that the high-strain zone has a history of both thrust and normal displacement. The zone may have an early thrust history related to early-syn and syn-metamorphic east-west shortening of the supracrustal rocks and a late-syn or post-metamorphic history of normal displacement.

<sup>1</sup> Contribution to NWT MDA Project C 1.1.7 carried by Geological Survey of Canada

### **GEOLOGICAL SETTING OF STRATABOUND GOLD OCCURRENCES IN THE ARCHEAN FISH-HOOK - TURNER LAKES BELT, BATHURST INLET AREA, DISTRICT OF MACKENZIE, NWT<sup>1</sup>**

C.W. Jefferson, M.N. Henderson, J.R. Henderson  
Geological Survey of Canada  
S. Schaan  
Ottawa-Carleton Geoscience Centre

Three deformation phases are documented in the belt. Where distinguishable,  $S_1$  is parallel to  $S_2$  and is crenulated by  $S_2$ . The latter is marked by alignment of metamorphic minerals (cordierite and andalusite) which include  $S_1$ , indicating that the peak of metamorphism occurred during  $D_2$ . An upright, southwest plunging  $D_2$  antiform preserves reclined  $F_1$  and  $F_2$  on its hinge, implying horizontal transport during  $D_1$  and  $D_2$ . Tonalites were intruded during late stages of  $D_2$ , before  $D_3$  and before  $D_4$ . The stratigraphy of the supracrustal sequence, from the base, is: (1) greywacke, (2) iron formation, (3) angular unconformity, (4) polymictic conglomerate (James Falls Conglomerate), (5) complex sequence of arenite, conglomerate, volcanic, hypabyssal and volcanoclastic rocks, (6) greywacke. High strain zones border a central belt dominated by sequence (5). Stratabound gold prospects spatially coincide with macroscale  $F_1$  hinges in sulphidic iron formation (Fish-hook Lake, Inf.) and sulphidic arenite (Turner Lake).

<sup>1</sup> Contribution to Canada-N.W.T. MDA Project C 1.2.1 carried by the Geological Survey of Canada.

### **STRUCTURE, STRATIGRAPHY AND CHANGES IN AURIFEROUS IRON-RICH ARCHEAN SEDIMENTARY ROCKS OF NORTHEASTERN SLAVE PROVINCE, N.W.T.<sup>1</sup>**

C.W. Jefferson, R. Lustwerk and M.B. Lambert  
Geological Survey of Canada  
S. Fumerton  
Chevron Minerals  
K. Hudson  
Sirius Energy Corp. Ltd.  
R.A. Olson  
Trigg, Woollett, Olson Consulting Ltd.

Three continuous and distinct iron-rich sedimentary sequences punctuate volcanic and turbiditic strata in the Back River area. Sequence A occurs within the Back River volcanic pile and is the thickest of several thin sedimentary units which mark temporary cessation of volcanism and

partial reworking of volcanic protoliths. It is lithologically diverse, containing calcite-cemented volcanic breccia to gritty limestone, magnetitic chert, graded volcanoclastic rocks and slate, all of which are variably sulphidic. Although this sequence is extensively staked, no significant gold prospects have yet been discovered.

Sequence B is regionally continuous and separates a thick sequence of volcanic rocks from overlying turbidite-dominated strata. Lean cherty iron-formation characterizes sequence B. The sequence includes, from bottom to top, various combinations of the following: dolomite- to siderite-impregnated breccia and granule breccia, oolitic and stromatolitic dolomite, magnetite-, sulphide- and siderite-chert beds, a marker unit of sulphidic volcanoclastics, greywacke or slate, sulphidic chert and carbonaceous slate, which grades upward into turbidites. Previously documented stratabound, grey, sulphidic quartz veins are the most auriferous rocks in sequence B. Mineralogical facies of iron-formation vary within 100's of metres laterally, and 1-10's of metres vertically. The lateral mineralogical, as well as clastic facies changes, suggest variations in both paleoenvironment and volcanic paleotopography.

Sequence C is hosted by turbidites and is located in many parts of the study area. It consists of: 1) basal and/or capping graphitic slate, 2) extensive argillaceous to cherty magnetite iron-formation with intense magnetic signature, 3) locally developed sulphide or silicate iron-formation with subdued magnetic expression and moderate to weak conductivity, 4) chert nodules, and 5) cross-cutting, white quartz veins. A complete spectrum from magnetite-silicate through mixed magnetite-sulphide-silicate to sulphide-silicate iron-formation has been observed. Iron-formations in the Sequence C facies association are spatially associated with thin to thick volcanoclastic units within the turbidites. In the Back River Complex iron-formation has been mapped very close to, but separated from, felsic domes and related conglomerates that are interbedded with turbidites. Most stratiform (no genetic implications) and stratabound gold prospects in the northeastern Slave Province are part of this turbiditic facies association.

Quartz veins in supracrustal rocks of northeastern Slave Province are most abundant in high strain zones and cross-cutting competent units such as thick turbidite and arenite beds, hypabyssal intrusions and iron-formations. The association of quartz veins with various combinations of sulphide, garnet, amphibole, chlorite, tourmaline, arsenopyrite and gold is, however, best developed in iron-rich sequences. An unusual example is specific units of pyrrhotitic arkose at Turner Lake that are enriched in gold with respect to adjacent less-sulphidic arenites, even though both rock types are transected by white quartz veins.

Tuffs associated with all three sequences have been sampled to determine whether they are geochronologically, as well as lithostratigraphically, distinct. The iron-rich strata constitute structural markers which have proved indispensable to the physical and geophysical tracing of complex fold geometries.

<sup>1</sup> Contribution to Canada-NWT MDA Project C1.2.1 carried by Geological Survey of Canada



# PRELIMINARY GEOLOGY OF THE TORP LAKE METASEDIMENTARY BELT, WESTERN BATHURST INLET (76 N/5,6,3)

Robert M. Johnstone  
GNWT

Canada-NWT Mineral Development Agreement

The Torp Lake metasedimentary belt is 580 km north-northeast of Yellowknife in the northern Slave Province. It extends 45 km north from the James River (Figure 1). The belt consists of Archean metasedimentary rocks of the Yellowknife Supergroup and is bordered to the west and south by granitic batholiths and to the east by the north-northwest trending Bathurst Fault. The Proterozoic Goulburn Group underlies the area east of the Bathurst Fault. Geological mapping at a scale of 1:30,000 is part of a three year project to map areas of gold potential in the lower Hood-James River region.

The metasedimentary rocks are almost entirely medial to distal turbidites comprising thin to moderately bedded fine-grained wacke, laminated and thin bedded mudstone and siltstone and minor pebbly wacke. Thick bedded arenite and a few 1-4 m thick, iron formations (oxide-facies) occur along a granite contact at the southernmost end of the Torp Lake Belt. Sedimentary structures, including cross-laminations, cross-bedding, slumps and scours, are common in the turbiditic metasediments despite deformation and widespread amphibolite facies metamorphism.

The contact between the plutonic rocks and the metasedimentary rocks is extremely irregular. Along the western edge of the Torp Lake belt, lobes of granite and granodiorite partly or completely enclose slivers of country rock as much as 1 km long. Granitic magma appears to have intruded as sheets along bedding planes without rotating the strata.

The biotite-hornblende granite/ granodiorite surrounding the belt is weakly to strongly foliated and medium-grained. This is intruded by stocks of muscovite-biotite granite which have porphyritic and pegmatitic phases but are generally massive and medium-grained. These rocks locally contain a marginal foliation. Pegmatite dykes are common throughout the region but are concentrated in two areas; between Torp Lake and the James River and along the southeastern edge of the belt. The dykes in the Torp Lake area are 1-50 m thick and are aligned subparallel to a northwesterly structural trend. Pegmatites typically contain muscovite and scori and less commonly almandine, apatite, spodumene and lepidolite.

A 1 to 4 km wide zone of tonalitic dykes and stocks extends for approximately 25 km along the southwestern edge of the Torp Lake belt. Most of the dykes trend subparallel to bedding, are 0.1-30 m wide and carry xenoliths of supracrustal rock. The tonalite is medium-grained and moderately to strongly foliated. The pervasive intrusion of the country rock by the tonalite dykes combined with a strong tectonic overprint produces a banded appearance to some of the rock in this zone. Although rare, paragneiss does occur in this area as well. The stocks of tonalite are confined to the central core of the intrusive zone,

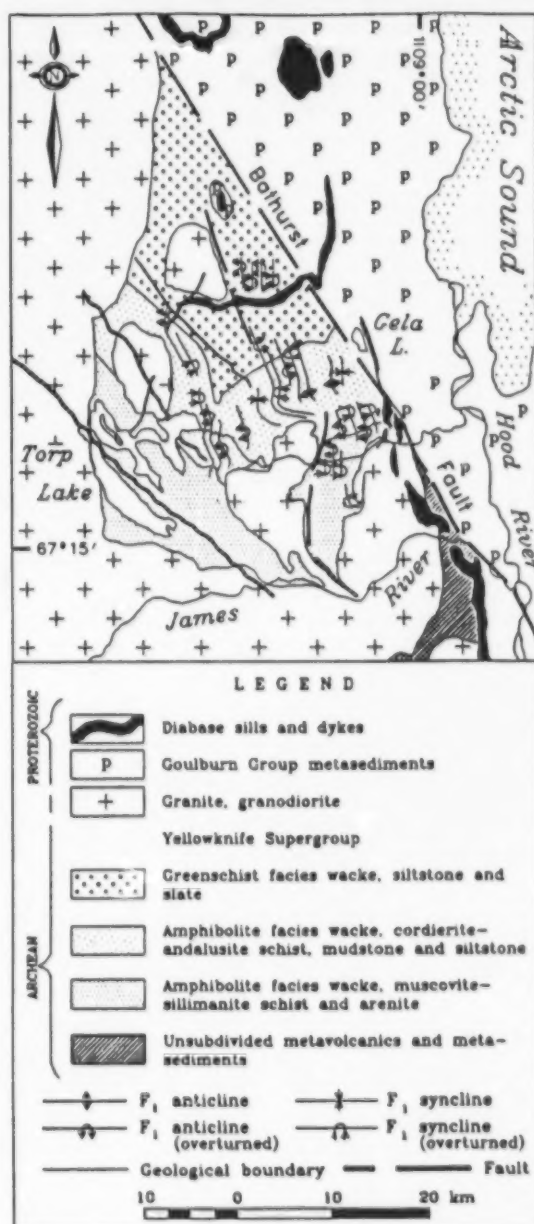


Figure 1: Geology of the Torp Lake Metasedimentary Belt.

extending for about 15 km northwest of the James River. Many of the xenoliths within the tonalite stocks are of amphibolite, migmatite and banded iron formation which are not typical of the Torp Lake belt.

Mafic to Intermediate Intrusives include a small stock of diorite (Archean), a gabbro dyke (Proterozoic), diabase sills (Proterozoic) and three sets of diabase dykes (Proterozoic). Diorite which has been intruded by pegmatite dykes, is weakly strained but retains an igneous texture. The gabbro dyke is approximately 90 m wide and intrudes the Bathurst Fault. Gabbro is brecciated where cut by faults and weathers brick red, similar to the Goulburn Group siltstone and



intrude gently east-dipping Proterozoic strata exposed between Gela Lake and the James River. The same diabase is found as a large, 50-60 m thick, flat-lying sheet disconformably overlying Archean rocks on the west side of the Bathurst Fault. Mackenzie diabase dykes, 10-150 m wide, trend northwesterly through the region cutting the sills. A few 10-50 m wide, northeast trending diabase dykes post-date the Mackenzie dykes. The youngest intrusive in the region is a 100-200 m thick, moderately north to northwest dipping Franklin diabase dyke which trends westerly across the center of the belt.

Metamorphic grade increases southward with a transition from greenschist to amphibolite facies approximately half-way along the length of the belt. This increase in metamorphic grade is indicated by a succession of west-trending metamorphic mineral zones (biotite, cordierite+andalusite and sillimanite+muscovite).

Strata strike northwest in the southern end of the belt and north to north-northwest elsewhere. The majority of the bedding dips moderately to steeply on the limbs of isoclinal folds ( $F_1$ ). Most of the folds are overturned towards the west and southwest. The folds are 2-12 km in length and generally plunge shallowly to the south. However, exposed fold closures are rare and at least two folds plunge moderately north. A bedding parallel foliation ( $S_1$ ), preserved in psammitic rocks, pre-dates the  $F_1$  folds. Axial planar fabrics associated with the folds have not been identified.

Many of the pelitic rocks in the south-central part of the belt have cordierite porphyroblasts containing inclusion trails of mica and quartz which define a foliation which developed prior to the peak of metamorphism. This foliation ( $S_2$ ) has a northwest orientation which is subparallel to bedding and axial planar to tight folds in quartz veins in this area. A steeply dipping, northwest striking biotite foliation developed in tonalite dykes and stocks may be  $S_2$  as well.

Steep northeasterly plunging open folds ( $F_2$ ) with east to northeast striking and steeply dipping axial planes are associated with an axial planar cleavage ( $S_3$ ).  $F_2$  deforms tonalite dikes,  $S_1$ ,  $S_2$ , and  $F_1$  fold axes. Fold amplitudes of 1 cm to 1 m are typical but range up to 50-150 m.  $S_3$  strikes northeasterly (15-60°) and dips within 20° of vertical. In pelitic beds  $S_3$  is expressed as a slaty cleavage in greenschist rocks and a schistosity or crenulation cleavage in higher grade rocks. Cordierite, andalusite and sillimanite porphyroblasts are undeformed but tend to be elongate parallel to  $S_3$ . Porphyroblast-matrix relations indicate that the porphyroblast growth occurred during the  $F_2/S_3$  crenulation event and terminated prior to the end of that same event. The development of  $S_3$  is interpreted to have been at syn-thermal peak conditions in the cordierite-andalusite and muscovite-sillimanite zones.

$F_1$  fold axes are deflected from regional trends immediately adjacent to biotite-hornblende granite stocks. As yet, it is not clear whether deformation was synchronous with or post-dated the emplacement of the stocks. In addition, Goulburn Group rocks and Proterozoic diabase dykes and sills (excluding Mackenzie diabase dykes) are gently folded about shallow north to northwest plunging axes.

Steeply dipping east striking and north striking faults transect the belt. Both sets of faults post-date granite emplacement and the north trending faults displace Proterozoic rocks and the Bathurst Fault. Most of the faults are dextral, producing displacements of less than 10 m. However, vertical displacements are undetermined and may be significant. The flat-lying diabase sheet next to the Bathurst Fault has been displaced at least 50 m by a north-trending normal fault (east side up).

The metasediments commonly contain disseminated, fine-grained pyrrhotite, arsenopyrite and chalcopyrite in low concentrations. However, pyrrhotite and particularly arsenopyrite are concentrated within narrow (<10 m) rusty weathering lenses bordering bedding parallel quartz veins. The metasedimentary rock hosting the quartz veins is usually amphibolitized. Assays of samples from such lenses have not indicated significant gold or silver contents. Samples of arsenopyrite, pyrrhotite and pyrite enriched quartz-carbonate veins from within north-trending shear zones found at the eastern edge and centre of the Torp Lake Belt have yielded anomalous gold and represent the best exploration potential.

Archean and Proterozoic rocks on either side of the Bathurst Fault display narrow fault breccias where quartz stockworks host chalcopyrite, bornite, sphalerite and galena.

The only exploration in the Torp Lake belt during 1989 was broad-scale prospecting conducted by BHP-Utah Mines Limited in the centre of the belt. There is one prospecting permit (PP. 1118) in the centre of the belt and a small claim (A.L. claim) on the Bathurst Fault.

## SURFICIAL GEOLOGY OF KATHAWACHAGA LAKE AREA (SOUTH HALF; 76 L)

Daniel E. Kerr  
Environmental Consulting Services

During the summer of 1989 surficial geology maps for 76 L/1 to L/4 were completed. The entire map-area was glaciated during the Wisconsin glaciation, and all glacial features are associated with this last glacial episode. Evidence for glaciation includes drumlins and drumlinoids (streamlined drift forms), eskers, kames, fluted bedrock and glacial striae. Drumlins are related to till blankets found at lower elevations, and are most common in 76 L/1 (east-west and northeast-southwest oriented features) and in 76 L/3 (north-south and northwest-southeast oriented features). This change in flow direction may be the result of a discontinuity in the flow pattern originating from two different ice lobes. Numerous eskers and kame deposits were found throughout the map-area, some are over 30 km long. These general trend is to the northwest. Based on radiocarbon dates in adjacent areas, it is likely that this region was generally ice-free by 9000 years BP, although scattered pockets of dead-ice may have persisted somewhat longer.

**PRELIMINARY RECONNAISSANCE  
OF THE SURFICIAL GEOLOGY  
OF THE  
YELLOWKNIFE RIVER BASIN, NWT**

Daniel E. Kerr  
Environmental Consulting Services

The study area was entirely glaciated during the last advance of the Laurentide Ice Sheet, and during this period, glacial erosion was a dominant process. The landscape exhibits widespread examples of roches moutonnées, fluted bedrock, glacially scoured lake basins, striae, grooves and chatter marks. Although till deposits are thin and discontinuous in the central and southern parts of the basin, broader expanses of till veneer are found in the northeast where streamlined drift forms (drumlinoids) are restricted. Flow indicators suggest that the ice moved to the west to southwest in the north, and to the southwest in the central and southern parts of the basin. During deglaciation (9000-8000 years BP), numerous eskers, kames and outwash complexes were deposited, some of these were developed along structural trends such as faults and joints. Most eskers consist of a series of short elongated segments of sand and gravel, giving a beaded appearance. They trend west to southwest. Following deglaciation, the southwest region of the basin was inundated by Glacial Lake McConnell, up to an elevation of 275 m a.s.l. During this period silts and clays were deposited. These are found today in the many depressions along lakes and rivers in the area. As lake level fell, it is likely that wave action winnowed till and lacustrine deposits, leaving perched erratics and lag deposits on bedrock surfaces, and occasionally forming boulder beaches.

**CURRENT FIELD ACTIVITIES OF THE  
GEOLOGICAL SURVEY OF CANADA  
IN THE NORTHWEST TERRITORIES**

J.E. King  
Geological Survey of Canada

The scope of the numerous geoscientific projects being conducted by the Geological Survey of Canada in the Northwest Territories ranges from regional mapping to operating the Yellowknife seismological array. Regional bedrock mapping is continuing in the central Slave Province and has been completed in the central Great Bear Magmatic Zone and Rankin Inlet area. More detailed map studies are being conducted elsewhere in areas of high economic or scientific interest, for example, analysis of the stratigraphic and structural setting of gold mineralization west of Bathurst Inlet, Au and Cu-Ni in the Rankin-Kaminak area, mineralized alteration halos around the Mystery Island Intrusive Suite near Port Radium, and direct dating of gold deposits.

A number of prospects and deposits are being analyzed in detail as part of regional metallogenic studies. Examples of this work include examination of Au mineralization in the Kaminak, Hood River and Back River

areas, Cu-Ni in the Kaminak Greenstone belt, Au-Bi-Co-Cu in the southern Great Bear Magmatic Zone, and Pb-Zn in the northern Cordillera. Airborne gamma ray spectrometry surveys in the Thor Lake, Lupin and Fort Resolution areas were followed up by ground-based data collection in order to constrain interpretation of the survey data.

The Geochronology Laboratory has derived numerous U/Pb ages and isotopic analyses (e.g. Nd/Sm) from rocks throughout the N.W.T.. These data have proved essential to constraining tectonic and metallogenic models in Precambrian rocks.

Mapping of surficial geology is continuing in various locations throughout the Arctic archipelago and Arctic coast. Permafrost and geotechnical research is being conducted in the Mackenzie corridor and along the coast of the Beaufort Sea. Projects specific to Global Change, in particular studies of the paleoclimate record of the Late Quaternary and Holocene, are of increasing importance as these data may help assess the impact of predicted climate changes over the next 50 years.

Integrated stratigraphic, sedimentologic, biostratigraphic and structural studies are being conducted in the Proterozoic rocks of the northern Cordillera and the Arctic archipelago. Marine surficial geology is being examined in the Beaufort Sea, Hudson Strait and on the Arctic Ocean shelf, and marine biostratigraphy in Hudson Strait. Geophysical field work includes geomagnetic observations and calibration of seismographs throughout the Arctic, an aeromagnetic survey of the Lincoln Sea, and gravity measurements in Peel Sound and Barrow Strait.

**REGIONAL GEOLOGY OF THE CONTWOYTO-NOSE  
LAKES AREA**

J.E. King  
Geological Survey of Canada  
C. Relf  
Queen's University  
W.J. Davis  
Memorial University

Metaturbidites of the Cogead and Beechey Lake Groups southeast of Contwoyto Lake appear to be coextensive. However, a zone of intense migmatitic injection obscures the possible eastward continuation of the Contwoyto and Itchen Formations of the Cogead Group. Most of the granitic leucosome of the migmatized domain has been injected into the presently exposed metaturbidites and is not in situ partial melt. The margins of the migmatized domain therefore do not coincide with a metamorphic isograd, although mineral assemblages typical of high metamorphic grade (e.g. cordierite-K-feldspar) occur within the domain. Iron formation was observed at several localities in the migmatized metaturbidites east of Contwoyto Lake, but it is fragmented and discontinuous due to migmatization.

Orthogneisses composed of tonalite and hornblende-plagioclase-biotite layers occur within the migmatized domain

and as xenoliths in syn-volcanic (?) plutons. These rocks may represent metamorphosed and injected volcanic or intrusive rocks. Two newly recognized, recrystallized, biotite tonalites are interpreted on lithologic grounds to be approximately syn-volcanic in age. Numerous hornblende +/- biotite-bearing gabbro to granodiorite plutons are correlated with magmatism that occurred during intense regional shortening ( $D_2$ ) and high T/low P metamorphism. Large volumes of biotite +/- muscovite tonalite to granite are interpreted to have been emplaced after the thermal peak of metamorphism during late cross folding. However, some of these plutons contain  $S_2$ , suggesting that they were emplaced during  $D_2$ .

## INTERACTIONS OF GRANITOIDS AND PILLOW LAVAS AT THE IDA POINT GOLD SHOWINGS, N.W.T.

Simon Leclair  
Université du Québec à Montréal

The Hope Bay Greenstone Belt (HBGB) is part of the Bathurst block in the Slave Province, N.W.T. (Gebert, Figure 1, page 33). It is the subject of a 1:50000 mapping project undertaken by the CANADA-NWT Mineral Development Agreement (MDA). It is particularly favourable for economic ore deposits because of its low metamorphic grade and the abundance of mafic volcanics which has a high potential for mineralization (Boyle, 1979, Colvine, 1988). In fact, the mapping project (led by James Gebert) has shown that the belt contains many high potential showings of either silver or gold in its interior or on its periphery. The Ida Point gold showing is on the northern most tip of this belt and represents an atypical contact gold showing between the belt and the surrounding granitic terrain. This showing is the subject of a masters thesis study by the author (Gebert, Figure 1, page 33) at the Université du Québec à Montréal, Dr. Michel Jébrak, supervisor.

The thesis focuses on the interactions of the granitoid rocks and the mineralization. This summer two weeks were spent mapping the area. The project was supported by the MDA. Factors under study include: 1) the petrology of the host rocks, 2) the nature of the prevailing structures, 3) the relationships between the mafic volcanics and granitic rocks, 4) the mineral genesis and 5) the source of the mineralization. This information could provide guides for prospecting the HBGB.

The main rock units at Ida Point are pillow lavas and massive flows cut by large proterozoic diabase sills to the west and by granitoids to the east. The younging direction as revealed by the pillow lavas is to the east. Minor volcaniclastic sediments are also present. Spatial relations indicate that they are at the base of the volcanic

pile. The volcanics are cut by a porphyritic mafic dyke by a late lamprophyre dyke and by minor felsic dykes. This part of the belt is regionally metamorphosed to greenschist facies (Gebert, 1989).

Three vertically oriented schistositys are recognizable. The pillows are all symmetrically elongated on a ratio of 5:1 in a north-northwestern pattern, this may be an indication for initial pure shear. Two other simple shear directions are respectively north-northwest, sub-parallel to the long axes pillows, and north-east. Milky white microscarcoidal quartz veins have developed parallel to the first shear direction (N-S). Au mineralization is concentrated in a arsenopyrite rich layer found on the edges of the veins. Subhorizontal quartz veins, considered to be tension gashes are also associated with this first shear. Sinistral shear movement is indicated by rotation of quartz veins. The second shear contains smoky and white quartz, a strong carbonate alteration and visible gold. A relatively low magnetic anomaly determined with a portable magnetometer is associated with the carbonate alteration. Structural measurements and relationships show that a vertical ductile movement followed by an horizontal dextral movement took place in this shear system.

The granitoids are in a ductile fault and in contact with the mafic rocks (parallel with the pure shear direction). Attempts to stain these rocks with cobaltinitrite reveal that they are tonalites.

The rocks at Ida Point are metamorphosed up to lower amphibolite facies. Field relationships reveal that this may be post deformation and due to contact metamorphism by the tonalite.

The first concern of the study will be to reconstruct the context of emplacement of the tonalite and whether it is synvolcanic or syntectonic.

## References

- Boyle, R.W., 1979:  
The geology and geochemistry of gold deposits of the Yellowknife district; Geological Survey of Canada, Memoir 310, 193p.
- Colvine, A.C., et al., 1988:  
Archean Lode Gold Deposits in Ontario; Ontario Geological Survey, Miscellaneous Paper 139, 136p.
- Gebert, J., 1989:  
Preliminary Geology of Southern Hope Bay Metavolcanic Belt; EGS 1989 #8, Map with marginal notes.



## **GOLD OCCURRENCES IN THE INDIN LAKE SUPRACRUSTAL BELT**

John Morgan  
GNWT

Canada-NWT Mineral Development Agreement

The Indin Lake Supracrustal Belt is 200 km NNW of Yellowknife. It consists of metavolcanic and metasedimentary rocks with a slight preponderance of the latter. The supracrustal rocks have undergone several phases of deformation, at least two of which involved regional metamorphism and regional-scale folding. The observed NNE structural grain in the belt reflects the latest folding.

Gold occurrences in the belt fall into two main categories: (1) quartz stockworks in or adjacent to competent rock units which have undergone brittle rupture, e.g. metagabbro within pillowed mafic volcanics and (2) quartz stockworks in or adjacent to shear zones in metavolcanic rocks or in metasedimentary rocks close to contacts with metavolcanic rocks. Gold occurrences in volcanic rocks are relatively rare in thick mafic volcanic sequences, and tend to occur either within sequences with intercalated felsic volcanic rocks or near contacts with metasediments.

Mineralized quartz veins and surrounding rocks show evidence of deformation that post-dates emplacement of the veins at several localities: tension veins are folded and boudinaged and corresponding alteration minerals are deformed and metamorphosed (e.g. Cass Deposit); quartz veinlets are sheared, brecciated and rotated (Treasure Island Main Zone); quartz pods are deformed in a shear zone (Pop Grid); and quartz veins are slightly buckled (Colomac).

In several cases vein deformation does not appear to be progressive starting with vein emplacement; at least some of the veins were emplaced during an early tectonic event, then were deformed and metamorphosed during a later event.

## **LOWER PALEOZOIC TECTONIC DEVELOPMENT OF THE NORTHERN CORDILLERA AND ASSOCIATED LEAD-ZINC MINERALIZATION**

David W. Morrow  
Institute of Sedimentary  
and Petroleum Geology

The lower Paleozoic sequence of the Northern Cordillera may be divided into two parts by the style of their tectonic evolution. Cambrian to Upper Silurian strata reflect an extensional tectonic regime that caused the development of Richardson Trough, Misty Creek Embayment and Root Basin. The juxtaposition of Root Basin, which underwent rapid subsidence, with the Mackenzie-Redstone Arch farther north suggests that extension may have been asymmetric

and occurred by detachment across a narrow master fault zone that extended obliquely through the entire crust to the underlying mantle. Root Basin at this time, may have been a 'lower plate margin' juxtaposed to an 'upper plate margin' represented by the Mackenzie-Redstone Arch. During deposition in Root Basin, of the upper part of the lower Paleozoic (Devonian), extensional thinning was accompanied by extremely rapid subsidence, up to 100 meters per million years. By contrast, the thick upper plate of the northern Mackenzie region may have been affected by the development of thermal arches, such as Twitya and Keele Arches. This arching was accompanied by erosion of underlying strata. Unlike the earlier Mackenzie-Redstone Arch, Twitya Uplift became the site of enhanced subsidence immediately following uplift and erosion which is consistent with a thermal origin.

Fracturing of the Siluro-Devonian sequence in the Godlin Lakes area during Devonian tectonism may have provided access for mineralizing solutions to form the numerous lead-zinc showings hosted in Devonian strata in the western Mackenzie Mountains. The zinc-rich Duo Lakes Formation shales of the Misty Creek Embayment, that underlie parts of this region, are an obvious source bed for these carbonate-hosted showings. This formation and other coeval Road River shales are markedly enriched in base metals. Mineralization may have occurred in Late Devonian time as indicated by lead isotopic data or possibly later in early Mesozoic time.

## **GEOLOGY OF THE GOLD-BEARING ZONES AT GEORGE LAKE AREA BACK RIVER REGION, NWT**

R.A. Olson  
Trigg, Woollett, Olson Consulting Ltd.

George Lake is north of Back River, about 515 km northeast of Yellowknife, NWT and 175 km east of the Lupin gold mine.

During early 1982, a project to explore Back River region for gold-bearing iron formation was conceived by Trigg, Woollett, Olson Consulting Ltd. This program resulted in the acquisition of several mineral properties in the Back River region, including the properties at George Lake. The George Lake property is now the focus of the George Lake Joint Venture, which was established in early 1989. The participants in the George Lake Joint Venture are Homestake Mineral Development Company, a subsidiary of Homestake Mining Company of California, and Kerr-McGee Corporation of Oklahoma (73.75% and 26.25%, respectively). Other properties in the Back River region form part of the Back River Joint Venture, which includes the MacIab Group of Edmonton as a Venture partner.

Back River region is in the northeast part of Slave Structural Province, and is underlain by Archean Yellowknife Supergroup and by intrusive rocks which probably are both older and younger than Yellowknife Supergroup. The Archean rocks are unconformably overlain by sedimentary rocks of Aphebian Goulburn Group. Yellowknife Supergroup comprises volcanic rocks of the Back Group and Hackett River Group that are, in part, coeval with sedimentary rocks



of Beechey Lake Group. Beechey Lake Group consists predominantly of greywacke and mudstone, but in several places iron formation exists. Many of the iron formations are gold-bearing. At George Lake area, the greywacke and iron formation are folded and faulted. These structures are of more than one age. Both brittle and ductile faults are present. There is a spatial association between some ductile faults and the gold-bearing zones; however, the exact genetic relationship is unknown.

Prospecting of iron formation in the Back River region since 1982 has led to the discovery of numerous gold occurrences which have been secured by the Joint Venture through acquisition of prospecting permits and mineral claims. These include several occurrences at George Lake area from which rock grab samples assay up to 20 grams gold per tonne or more. Most of the more important gold-bearing zones are hosted in an oxide iron formation. The oxide iron formation ranges from less than 10 m to greater than 100 m in true thickness, and averages about 40 m. There are three spatially separate belts of oxide iron formation at George Lake area. The oxide iron formation has a strike extent of greater than 50 km. All the gold-bearing zones in iron formation are associated with more restricted sulphidic zones, which comprise pyrrhotite, arsenopyrite and pyrite. Pyrrhotite is the predominant iron sulphide at depth. Most sulphidic zones are associated with quartz veins. There are at least three sets of quartz veins, each with a different attitude. Silicification, chlorite and, in places, hornblende, graphite and carbonate are also common in gold-bearing sulphidic zones. The sulphide zones can occur throughout the thick oxide iron formation, but tend to be more common at or near the stratigraphic footwall. The reason for this is uncertain.

A total of about 48,230 m in 269 holes have been drilled on the George Lake Joint Venture project. Most of the drilling has been performed at five targets. At each of these targets, drilling has defined a gold deposit with a geological inventory ranging from about 200,000 tonnes up to about 1,000,000 tonnes, with a grade of at least 10 grams gold per tonne. Additional exploration is required at each of these five targets and at a number of other targets at George Lake area.

#### TECTONOSTRATIGRAPHY OF THE ARCHEAN ROCKS OF THE TAVANI AREA, DISTRICT OF KEEWATIN, NWT<sup>1</sup>

A.F. Park and S. Raiser  
University of New Brunswick

The Archean rocks of the Tavani area of the Rankin-Ennadai Belt have been remapped over two summers (1988-89). Principal conclusions to this study are:

1. The Kaminak Group is raised to Supergroup status, sub-divided into the Kasigialik Group and the Tagiulik Group (new names). The Kasigialik Group consists of a lowermost Atungag Formation (new name), dominated by pillow basalts; a middle Akiqnaktuk

Formation (new name), consisting of felsic and epiclastics rocks at the top and mafic to intermediate volcanic and epiclastic rocks below; and an upper Evitaruktuk Formation (new name), consisting of quartz-bearing turbidites with shaly, arkosic and conglomeratic facies. The Tagiulik Group consists of psammitic and semipelitic, feldspathic and quartz-poor, volcanoclastic turbidites with iron formation.

2. The Kasigialik and Tagiulik Groups are separated by a shear zone representing a major décollement. The Tagiulik Group is entirely contained within a nappe lying above the Kasigialik Group, and its depositional and chronological relationship to the Kasigialik Group is unknown.
3. Structure is dominated by open, upright  $F_1$  folds and  $D_2$  shear zones.  $D_1$  features, including cleavage and minor fold developments, do not produce any major changes of younging or facing, indicating that the lack of large scale  $F_1$  folds through most of the area is a real feature, rather than being due to paucity of critical outcrop. Only in the relatively well-bedded Tagiulik Group and Evitaruktuk Formation is an interference pattern between  $F_1$  and  $F_2$  folds developed.
4. Metamorphism can be related to structure in that the various structural domains in the area coincide with metamorphic domains. Overall, greenschist facies or locally lower grade assemblages dominate, with areas of higher grades, including amphibolites and migmatites, appearing to the north, west and south-east. Shear zones can carry both prograde and retrograde mineral assemblages. Metamorphic aureoles exist around some of the late tectonic granitoids.
5. Structure, granite emplacement and metamorphism can be related closely in the southeastern Tavani complex, a dome structure in which granite with marginal migmatite is mantled by amphibolite. The dome is circumscribed by high and low angle shear zones, across which there are rapid changes in metamorphic grade. Extensional faults at low angles to, and lying within shear zones, are widespread, producing many features consistent with an interpretation of the Tavani complex as a "metamorphic core complex" emplaced during  $D_2$  deformation.
6. The abrupt change in metamorphic grade, coincident with change in structural style and major shear zones, evident across a line drawn through Gill Lake-Maze Lake-Last Lake, indicates the presence of a major tectonic boundary within the Rankin-Ennadai belt. The similarity of lithologies across this feature implies that it is an orogenic front rather than a major "terrain" boundary.
7. Mineral deposits, and suitable hosts show both stratigraphic and tectonic controls. A belt of amphibolite facies Atungag Formation, coincident with the broad ductile shear zone on the western margin of the Tavani complex, is host to both diffuse and massive sulphide mineralization (pyrite-copper sulphides). Chert-exhalite horizons are components of discrete lithofacies within the Evitaruktuk and Atungag Formations, as are carbonate-

iron formation and sulphidic pelites. Magnetite banded iron formation of sulphidic, pelitic- and chert-type are an important component of the basal Tagliuli Group while chert-type iron formations occur throughout this turbidite succession. Quartz-carbonate veins, including sulphides (galena and several copper minerals), formed as a consequence of the hydrothermal activity during the cooling of late tectonic granites. Elsewhere, quartz veining, including the gold-bearing veins at Fat Lake, reflect competence contrasts between metagabbro bodies and their hosts during D<sub>1</sub> and D<sub>2</sub>.

<sup>1</sup> Contribution to NWT MDA Project C 1.1.3 carried by Geological Survey of Canada.

# **RARE-METAL MINERALOGY OF THE LAKE ZONE AND ASSOCIATES SILICA-UNDERSATURATED ROCKS, THOR LAKE DEPOSIT, NWT**

D.R. Pinckston & D.G.W. Smith  
University of Alberta

The Thor Lake rare-metal deposit is 100 kilometres SE of Yellowknife along the north shore of Hearne Channel, Great Slave Lake, NWT. Situated within the peralkaline portion of the Blatchford Lake Intrusive Suite are five mineralized zones enriched in Be, Y, REEs, Zr, Nb, Ta, Li, Ga, U and Th. The largest of these zones, the Lake Zone, contains significant Nb-, Zr-, Y- and REE- mineralization associated with an altered, central region of the Thor Lake syenite. Overall, the associated rock types, geometry of the intrusions and styles of mineralization are comparable to numerous alkaline intrusions in Nigeria, East Africa and Saudi Arabia.

In the Lake Zone, Zr is confined to zircon which occurs either as euhedral grains, severely metamict anhedral crystals or as a poorly formed 'hydrothermal' phase. Nb is found in a number of minerals including: aeschynite and pyrochlore group minerals, fergusonite-(Y), ferrocolumbite and samarskite-(Y)(?). Of these Nb-bearing minerals, ferrocolumbite is the most common in the Lake Zone. Because both Ta concentrations in the niobates and Hf values in zircons are low, rare-metal fractionation within the Lake Zone, especially compared to rare-metal pegmatites, has been minimal. REE-bearing minerals include the bastnäsite group, monazite-(Ce) and allanite-(Ce). Fergusonite-(Y), zircon and infrequent xenotime-(Y) are the only Y-bearing minerals. All economically important minerals are found to have formed in two general stages; the first features relatively well-formed grains and the second, more prevalent stage exhibits finer grained, poorly defined crystals.

Immediately underlying the Lake Zone is a body of silica-undersaturated rocks believed to be, in part, responsible for rare-metal mineralization in the Lake Zone. Most common is nepheline syenite although urtites, ijolites and sodalite syenite have been found. Rare-metal-bearing minerals such as zircon, cerianite-(Ce), britholite-(Ce), allanite-(Ce), thorite and other minerals, some of which appear to be new species, are found clustered into small clots. These pockets have formed at low temperatures in a highly oxidizing environment and give evidence for late-stage metasomatism affecting both these silica-undersaturated rocks and the overlying Thor Lake syenite.

# **DIAGENESIS OF MIDDLE DEVONIAN PRESQU'ILE BARRIER - IMPLICATIONS ON ORIGIN OF DISSOLUTION VUGS AND BRECCIAS AT PINE POINT AND ADJACENT SUBSURFACE<sup>1</sup>**

Hairuo Qing and Eric Mountjoy  
Department of Geological Sciences  
McGill University

Mississippi Valley Type (MVT) deposits in Pine Point are closely associated with dissolution vugs and breccias, which are commonly interpreted to be related to meteoric karst systems. The associated coarsely crystalline saddle dolomites were suggested to have formed in a meteoric-sea water mixing zone environment.

It is difficult to determine how much dissolution can be attributed to meteoric water influence during the Watt Mountain exposure because later mineralization has almost completely overprinted and obliterated the earlier diagenetic features in the Presqu'ile barrier at Pine Point. To solve this problem, we have studied core samples from 32 wells from the adjacent subsurface Presqu'ile barrier, where the influence of the later stage hydrothermal fluids can be easily identified. Our study suggests that dissolution related to the Watt Mountain exposure differs from the dissolution associated with the MVT deposits at Pine Point at least in three aspects:

- 1) The size of vugs related to the Watt Mountain exposure is small, usually 1 to 2 cm, while dissolution vugs that host MVT deposits at Pine Point are much larger, varying from a few centimetres to few metres;
- 2) Dissolution features that were resulted from Watt Mountain exposure are restricted below the Watt Mountain unconformity. Locally at Pine Point and also in the subsurface, however, large scale dissolution and brecciation occurred continuously above the unconformity;
- 3) Dissolution vugs and breccias related to Watt Mountain unconformity are commonly filled with green shale, and locally with pendant cements, which are diagnostic of the vadose zone. The dissolution vugs at Pine Point are filled with saddle dolomite, sulphide minerals, and other late diagenetic products.

Therefore the role of Watt Mountain exposure has been over-emphasized. The dissolution that host MVT deposits at Pine Point must occur some time after Watt Mountain exposure. The intimate relationship between large scale dissolution and massive occurrence of saddle dolomite suggests that the main dissolution was caused by hydrothermal fluids in the subsurface which precipitated saddle dolomites and dolomitized host limestones as indicated by the isotopes and fluid inclusions of saddle dolomite.

<sup>1</sup> Contribution to the NWT MDA Project C 1.2.6 carried by the Geological Survey of Canada.

## STRUCTURAL-METAMORPHIC STUDIES IN THE CONTWOYTO-NOSE LAKES AREA: AN UPDATE<sup>1</sup>

C. Reff

Queen's University, Kingston

Two sets of NE- and NW-striking cross folds which postdate pre- and syn-thermal peak isoclinal folding (D<sub>1</sub> and D<sub>2</sub>, respectively) have been identified in the Contwoyto-Nose Lakes area. Both are manifest as dominal, open to tight, upright folds and crenulations of bedding and S<sub>1</sub>, and regional (km-scale) open, upright cross folds. The relative timing of these two sets of structures is ambiguous, as both possible relative time relationships are observed. They have therefore been designated DNE and DNW, based on the strikes of their axial surfaces. The crenulation cleavage associated with DNE locally transposes the S<sub>1</sub> cleavage.

Metamorphic porphyroblasts have locally been crenulated by DNE or DNW, indicating that cross folding postdated the thermal peak. The two mapped isograds - cordierite and sillimanite - must therefore also have been affected by DNE and DNW. They define a basin-shaped thermal low centred on Contwoyto Lake, which is interpreted to result from the superposition of NE- and NW-striking synforms. A thermal "trough" that extends northeastward from the basin to the map boundary is interpreted as a DNE synform. A third isograd, corresponding to the muscovite breakdown reaction, has been obscured by the injection of granitic veins which impart a migmatitic texture to the metasediments.

<sup>1</sup> Contribution to the NWT MDA Project C 1.1.1 carried by the Geological Survey of Canada.

## SEDIMENTOLOGICAL EVALUATION OF THREE ARCHEAN METAQUARTZITE- AND CONGLOMERATE-BEARING SEQUENCES, SLAVE PROVINCE, N.W.T.<sup>1</sup>

R.J. Rice and W.K. Fyson

Ottawa-Carleton Geoscience Centre

D.G.F. Long

Laurentian University

S.M. Roscoe

Geological Survey of Canada

A sedimentological evaluation of three metaquartzite- and conglomerate-bearing sequences in the Slave province was conducted to ascertain their depositional settings and consequently their tenability as exploration targets for paleoplacer gold and uranium mineralization.

Approximately 10 km southwest of Newbigging Lake, in the southern extension of the Point Lake supracrustal belt, metasedimentary rocks occur interstratified with pillowed mafic metavolcanics. The phyllites, sub-mature metaquartzites and polymictic orthoconglomerates (granitic and mafic volcanic clasts) of this sequence represent an areally restricted submarine fan system. Boulder grade

(1-2 m) clasts in the conglomerates indicate that the fan(s) could have developed seaward of a submarine canyon(s). Turbidites (AE and/or CE) are apparently a volumetrically minor component of this fan system.

The Beniah Formation was examined 3 km west of the south end of Beniah Lake, in the central portion of Beaulieu River supracrustal belt. The formation is at least 231 m thick consisting of oligomictic quartz pebble and minor polymictic (quartz and volcanic clasts) orthoconglomerate, dominantly mature metaquartzite and minor phyllite which has been extensively intruded by gabbro. A conglomerate-free basal portion represents deposition in a mid to outer shelf setting whereas a higher energy inner to mid shelf setting is suggested for the conglomeratic upper portion. Coarser-grained metaquartzite units may represent storm events.

The Beaulieu Rapids Formation was examined 30 km south of Beniah Lake, along an 8 km stretch of the Beaulieu River system, in the central portion of the Beaulieu River supracrustal belt. The formation is ca. 1 km thick, consists of polydeformed sub-mature metaquartzite, polymictic orthoconglomerate and minor phyllite and lies unconformably on top of pillowed mafic metavolcanics. It represents sedimentation on a subaerial alluvial fan dominated by stream flow deposition of cobble- to boulder-grade detritus in the mid to upper fan areas and shallow ephemeral braided stream deposition of sand-grade detritus in more distal regions. The uppermost 52 m represent deposition in a deeper sandy braided fluvial setting, possibly flowing orthogonally to the alluvial fan.

The subaerial alluvial fan environment attributed to most of the Beaulieu Rapids Formation is one that is particularly favorable for pyritic paleoplacer concentrations of gold and uranium. The shelf environment of the Beniah Formation is less favorable and the submarine fan deposits near Newbigging Lake are unfavorable.

<sup>1</sup> Contribution to Canada-N.W.T. MDA Project C1.2.1 carried by Geological Survey of Canada.

## STRATIGRAPHY AND STRUCTURE OF A METASEDIMENTARY-VOLCANIC SEQUENCE AT BENIAH LAKE, SLAVE STRUCTURAL PROVINCE, NWT

D. Roach and W.K. Fyson

Ottawa-Carleton Geoscience Centre

Three belts of supracrustal rocks, apparently unconformable upon tonalitic gneiss, converge amidst granitic plutons at Beniah Lake: a segment of a narrow 100 km belt extending northward along the western margin of the area mapped is in faulted contact with an areally restricted central, NE-trending belt, which is separated by a dioritic pluton from a belt trending E to NE beyond the map area.



The three belts are stratigraphically similar. The lowermost section contains metamorphic rocks of the Beniah Formation, including quartz-pebble conglomerate, orthoquartzite, quartz arenite, siltstone, calc-silicate rock, volcanoclastic sediment, and felsic to intermediate tuff. The sediments and tuffs are intruded by laterally extensive sills of chromite-bearing dunite and pyroxenite, both metamorphosed to serpentinite. The top of the Beniah Formation is marked by thin, discontinuous, magnetite-chert iron formation. Rocks of the Beniah Formation and the underlying gneiss are intruded by voluminous (locally >50%) mafic dykes and sills metamorphosed to actinolite amphibolites. Overlying the Beniah Formation is a thicker metavolcanic sequence grading upsection from massive and pillowed mafic metavolcanics into intermediate and felsic tuffs. Unlike the tuffs of the Beniah Formation, the upper tuffs are not intruded by mafic dykes.

The rock types and stratigraphic relations of the three belts, and the presence of similar rocks extending at least 50 km northward, suggest an areally extensive pre-volcanic sheet of mature shelf sediments. The first volcanism was predominantly felsic accompanied by high level intrusion of ultramafic rocks (as evident by detrital chromite in the sediments). Subsequent mafic volcanism may have been related to the mafic dykes crossing the basal gneiss and Beniah Formation.

Structures reveal a complex history of deformation. Rocks within the NE-trending belt form a major, steeply plunging, SW-facing syncline with limbs curving southward parallel to foliation in the adjacent N-trending supracrustal belt. The E-trending belt curves southwest along the eastern contact of the dioritic pluton to form an open, steeply plunging, NW-facing anticline. The N-trending belt is highly foliated, including a 500 m wide steep zone of ductile sinistral shear that is most pronounced within the metasediments (Beniah Formation). The sinistral shear was imposed across a vertical stretching lineation well shown by elongated pillows in the volcanics. The E- and NE-trending belts are less deformed; steep bedding-parallel foliation is locally intensified into shear zones with pillows and quartz pebbles elongated down-dip. The mafic dykes intrusive into the Beniah Formation display penetrative fabrics which parallel those in the host metasediments.

An overall pattern of E-W to NW-SE crustal shortening is envisaged. Vertical extension in the sediments and volcanics was followed by strike-slip movements, particularly sinistral shear along the N-S belt.

#### **THE DAMP PROSPECT: VOLCANIC-HOSTED POLYMETALLIC (Cu-Fe-Co-U) BRECCIA MINERALIZATION**

M. Sawiuk, M. Cannull, J.A. Climie  
Central Electricity Generating Board

The Damp Prospect is a polymetallic, Cu-Fe-Co-U mineralized breccia hosted by caldera-related volcanics of the Apehian Great Bear Magmatic Belt.

The prospect was discovered in 1985 through application of an exploration model for Port Radium vein-type

U-Ag deposits. This model was based on GSC mapping which had demonstrated a systematic alteration zoning associated with high level intermediate intrusions in the region. An inner albite zone is flanked by central magnetite-actinolite-apatite and outer sulphide haloes. U-Ag occurrences in the Camell River and Port Radium camps are spatially associated with this alteration zoning.

The magnetic component of the alteration haloes was utilized as an exploration guide by CEGBE. EMR aeromagnetic data were digitized and colour plotted by Paterson, Grant & Watson Limited, and magnetic anomalies selected for ground follow-up. Zones of outcropping pitchblende-mineralized breccia were found associated with one of these anomalies in the Longtom Lake area.

The Damp breccia is hosted by calc-alkaline, caldera-related andesitic lavas and rhyodacitic tuffs intruded by quartz monzonite. The southeast striking, steeply southwest-dipping breccia is concordant with the volcanics. The zone has been traced approximately 275 m along strike and varies from 3-35 m in width, averaging about 9 m. Strongly albitized rhyodacite fragments support, or are supported by a magnetite-hematite-specularite cement. The breccia is flanked by a broad, 1 X 0.5 km zone of less intense albitization and an outer, more regional zone of magnetite-actinolite alteration.

Trenching of the mineralization returned values of up to 0.2% U<sub>3</sub>O<sub>8</sub> and 0.15% Cu over 16 m, including 1.4% U<sub>3</sub>O<sub>8</sub> and 1.39% Cu over 4 m. Other metal enrichments included Co (0.19% over 7 m), V (0.13% over 13.75 m), Zn (1.98% over 5 m), Ag (0.24 oz/t over 6 m) and Au (1.04 g/t over 4 m). Mineral phases identified to date include chalcophyllite, pitchblende, pyrite, covellite, bornite, siegenite (NiCo<sub>2</sub>S<sub>4</sub>), violarite ((Ni,Fe)<sub>2</sub>S<sub>4</sub>) and molybdenite.

Subsequent drill testing indicated that uranium values were enriched by supergene processes in the near surface environment and declined to low values with depth.

The Damp breccia is a variant of Port Radium style veins and is related to Apehian magmatic activity. Volatile-rich magmatic fluids associated with high level plutonism brecciated, mineralized and altered a vertical column of volcanics above the intrusive interface. Iron oxides and copper-cobalt sulphides were deposited within open spaces. The breccia is crudely analogous to hydrothermal breccial associated with porphyry copper style mineralization in younger continental arc settings of Phanerozoic age.

#### **PRELIMINARY REPORT ON GEOLOGICAL MAPPING AT TURNER LAKE, NWT**

S.E. Schaan and W.K. Fyson  
Ottawa-Carleton Geoscience Center

The Turner Lake - Pistol Lake area, northeastern Slave Province, is underlain by metasedimentary rocks including greywacke and conglomerate, with less extensive volcanic rocks. These are intruded by granitoid rocks forming bedding-parallel northerly trending sheets and large bordering plutons.



A preliminary stratigraphy has been established. Unit 1 consists of graded argillaceous turbidite and cross-bedded quartzose sandstone. Unit 2 is a polymict orthoconglomerate with sedimentary and granitoid clasts. Volcanic rocks (Unit 3) include a porphyritic amphibolite, banded amphibolite (mafic tuff) and massive chlorite schist (mafic tuff?). Unit 4 consists of interbedded quartzose sandstone, similar to that in Unit 1, quartzite and amphibolite. Units 5 and 6 are interlayered sheets of granodiorite, both porphyritic and non porphyritic, and diorite respectively. Granodiorite plutons (Unit 7) intrude the supracrustal rocks in the southern and western margins of the map area. Pegmatite bodies (Unit 8) are either layered containing tourmaline or podiform.

Major, high-strain zones, marked by schistose foliation and mylonitic rocks semiconcordant to the layering, trend northward. Gold is hosted in folded amphibolitic arenite and within quartz veins near one of the high-strain zones.

### GOSSANS ON NORTHERN MELVILLE PENINSULA

M. Schau and L.A. Dredge  
Geological Survey of Canada

Northern Melville Peninsula consists of Precambrian shield rocks, and is rimmed by Paleozoic limestones, especially to the east in Foxe Basin. The uplands are underlain by Archean granitoids and high grade metamorphic rocks with thin supracrustal belts, locally overlain by Proterozoic sediments and cut by later basic dykes.

Small gossans and minor sulphide concentrations are found in a number of units:

- 1) minor stringers of sulphides in silicate and/or magnetite-quartz iron formation or closely associated ultrabasic dykes, sills or flows (Prince Albert Group),
- 2) sulphides and local gossans within gabbroic units (Tasijuaq Gabbroic Suite),
- 3) gossans and sulphide veins in supracrustal tectoclinal ductile shear zones, and
- 4) gossans and veins in cataclastic fault zones.

Some exploration activity has focused on the supracrustal and basic units wherein gossans are not well developed, and little activity has centred on the shear zone gossans although they are visually the most spectacular. Grab samples collected by the authors yield disappointing values from all gossans.

A major ice sheet moved westwards out of Foxe Basin onto and across much of the peninsula during the Wisconsin Glaciation, transporting calcareous till derived from the Paleozoic units in Foxe Basin across the crystalline Shield terrain. Consequently, most of the region has been exposed to subaerial weathering for only 7-9 thousand years, and the plateau area (site of a local ice cap) may have been exposed for a much shorter period. Samples of surficial materials indicate that three types of glacial deposits are present;

- 1) regolith under a small ice-cap on the plateau,
- 2) mixed debris from the west moving glacier, and
- 3) special linear concentrations of allochthonous calcareous debris marking the locus of streaming flow within the ice sheet.

Trace element concentrations have been determined on the clay fraction of till and regolith samples. Values result from a mix of transported carbonate till and the in-situ regolith. In the gossans, thorough weathering of sulphides has left a residue in which concentrations of elements reflect their relative mobility; for example, Zn is leached whereas Cu and Pb are retained. The similarity in the style and rate of weathering in this area compared to that in other climatic regions indicate that existing geochemical models can be applied to Arctic regions but no secondary mineral deposits are likely present.

### THE POLARIS LEAD/ZINC MINE

R.J. Sharp  
Chief Mine Geologist  
Polaris Operations

The Polaris Mine, located on Little Cornwallis Island in the Canadian Arctic Archipelago, at 75°23'N, 96°56'W, has produced Pb/Zn concentrate since 1981. Jointly owned by Cominco Limited and Pine Point Mines Limited, the mine is operated by Cominco Metals and produces 3,000 tonnes of ore per day totalling one million tonnes per year.

Lead and zinc concentrate in the form of galena and sphalerite are derived from the ore and separated from a dolomite and marcasite gangue. The ore body is a stratabound carbonate hosted lead/zinc deposit with many features typical of the "Mississippi Valley" type deposits. At inception, indicated ore reserves totalled 20 Mt grading 3.8% Pb, 14.2% Zn and 3.8% Fe based on an 8% cutoff grade. Current indicated reserves are 13 Mt. Dimensions of the deposit are 800 m strike length, 300 m at its widest point and thickness ranging from 20 m in the Panhandle Zone to 100 m in the Keel Zone. Depth below surface to the top of ore ranges from 50 m on the west to 160 m on the east.

The mining method used at Polaris is sub-level longhole open stoping. Stope dimensions are typically 15 m wide, 120 m long and 30 m high. Permafrost extends below the lowest mine development where rock temperatures are -5°C at 280 m below sea level. Mined out areas are backfilled with rock quarried from surface, dumped down 2 m diameter raise-bore holes, and consolidated by freezing water.

Dolomitized limestone of the Ordovician Thumb Mountain Formation hosts the lead/zinc mineralization. Green calcareous shales of the Irene Bay Formation overlie it and green shale, limestone and evaporites of the Bay Fjord Formation underlie it. A significant proportion of the metal in the deposit lies in a tabular body, designated P1 ore, that approximately follows but gently transgresses down across the bedding in Upper Thumb Mountain rocks dipping 20°E throughout the mine area.

An extensive volume of brecciated dolomite healed by a network of galena/sphalerite veins and irregular masses, designated K3 - K1 ore, underlies the eastern down dip half of the P1 ore. The Keel Zone contains this lower stockwork ore whilst the Panhandle Zone does not.

Colloform and crustiform sphalerite and wurtzite are common throughout the ore body along with polycrystalline aggregates dominant in vein mineralization in the Keel Zone. Abundant well-formed galena and wurtzite crystals occur in small, ice-filled, vugs throughout the ore body. Marcasite is concentrated in the upper or P1 portion of the deposit. Lead to zinc ratios show a slight increase from .2 in lower to .3 in upper ore horizons.

Cross-cutting relationships show: that mineralization post-dates small folds; that small displacement thrust faults cut ore and these are in turn cut by later normal faults. The timing of mineralization best correlates with early Devonian movements of the Boothia Uplift.

#### **DRIFT PROSPECTING FOR GOLD AND BASE METALS, KASIGIULIK-TURQUETIL LAKE AREA DISTRICT OF KEEWATIN**

W.W. Shilts and P.H. Wyatt  
Geological Survey of Canada

During the summer of 1988, till and esker sediments were sampled around surface expressions of gold mineralization at two sites near Turquetil and Maguse Lakes in southern District of Keewatin. Geochemical analyses of the <230-mesh (<63  $\mu\text{m}$ ) fractions of these samples were carried out for gold, and a suite of trace and minor elements was determined in their clay fractions (<2  $\mu\text{m}$ ). In the Turquetil area, arsenic and gold anomalies gave clear responses around known mineralization as well as in areas of suspected mineralization. In the Maguse Lake test, only samples within a few metres of the mineralized outcrop yielded gold anomalies, possibly because the terrain has been reworked extensively during offlap of the postglacial Tyrrell Sea.

To put the detailed sampling in perspective, <230-mesh fractions of approximately 3000 archival samples from regional and detailed grids were analyzed for gold and for an extensive suite of trace and minor metals. These samples were collected during regional and detailed drift geochemical studies carried out around Kasigiulik Lake in the first half of the 1970's. Known gold occurrences and base metal mineralization with trace amounts of gold were delineated as were some unprospected areas not presently known to be sites of gold mineralization. A major dispersal train of metals with mafic or ultramafic affinities (known from previous work) was outlined in more detail in the region between Yandle and Henning Lakes. Mineralization responsible for this major train is thought to be hosted within a gabbro body at the north ends of these lakes. Analyses of these Ni-Cr-Co-Cu rich samples for platinum group elements yielded no detectable PGE concentrations.

#### **STRUCTURAL, GEOCHEMICAL AND $^{40}\text{Ar}/^{39}\text{Ar}$ DATING CONSTRAINTS ON THE FORMATION OF GOLD BEARING, METATURBIDITE HOSTED QUARTZ BRECCIA/VEIN SYSTEMS OF THE SOUTH GORDON LAKE REGION, N.W.T.**

T.R. Stokes, M. Zentilli, N. Culshaw,  
and P. Reynolds.  
Geology Department  
Dalhousie University

#### **Introduction**

A structural and lithologic model is proposed for the localization of stratabound auriferous, quartz breccia zones, hosted in lower greenschist grade Burwash metaturbidites of the Archean Yellowknife Supergroup (Stokes et al. 1989). The mineralized breccia zones occur in the hinge of a N-S trending, vertically plunging regional (km scale) refold at the southern end of Gordon Lake (lat.  $62^{\circ} 54' \text{N}$ ; long.  $113^{\circ} 15' \text{W}$ ). Of these breccias the most economically important is the Kidney Pond Zone 1 which has a strike length of 260m, a width of 5-20m and depth extent of at least 180m. Total reserves for this zone are 173,000 tons at 0.5 oz/ton Au, for assays cut to 3.0 oz/ton (Caelles et al., 1986).

The brecciation, probably the result of refold hinge tightening, started in and continued after peak metamorphism. The late tightening produced (predominately dextral) bedding parallel slip that: 1) developed a distinctive crenulation cleavage and 2) focused mineralizing fluids into the refold centre. A lithological transition, of alternating graywacke and black (carbonaceous) siltstone beds, situated within the centre of the refold (on the western shore of Gordon Lake) possibly enhanced this late deformation.

#### **Geochemical Constraints**

Eighty vein, breccia and lithological samples (including appropriate duplicates and standards) were analyzed for gold, trace and major elements. The purpose of this pilot study was to investigate: 1) evidence for an alteration halo around the main stratabound breccia at Kidney Pond; 2) the relationship between gold mineralization, sulphides (particularly arsenopyrite) and carbon; 3) the geochemical differences between the black siltstones, grey siltstones and graywackes and 4) the possible tectonic provenance of the metasediments.

Preliminary results from siltstone samples taken <5m to >200 m from the Kidney Pond Zone 1 breccia zone indicate: 1) a major element enrichment of  $\text{K}_2\text{O}$ ,  $\text{TiO}_2$ , and  $\text{Al}_2\text{O}_3$ , and a depletion of  $\text{SiO}_2$  towards the breccia; 2) no distinct trends in  $\text{CaO}$ ,  $\text{Na}_2\text{O}$ ,  $\text{MgO}$ ,  $\text{MnO}$ ,  $\text{P}_2\text{O}_5$  and  $\text{Fe}_2\text{O}_3$ ; 3) distinct gold and trace element (including As, Ni, Cu, Cr, Ba, Sr, and Rb) enrichment towards the breccia zone and 4) no distinct trends in Pb or Zn. From this data a distinct geochemical halo, of at least 20 m, is apparent surrounding the breccia zone.

Gold and arsenic appear spatially related with breccia systems. A log plot of arsenic versus gold concentration produced a linear correlation for both breccias and host lithologies; once a threshold value of approximately 50-100ppm arsenic is reached. This agrees with comparable data taken from Brophy (1987) that covers other areas within the Yellowknife Basin.

Siltstones within the Kidney Pond breccia zone display higher percentages of total carbon compared to the other surrounding siltstones and wackes. There also appears a close correlation between gold and total carbon within the breccia zone itself. The carbon, probably primary (organic) in origin, possibly played a role in: 1) reducing or scavenging gold from the mineralizing fluids and 2) assisting hydrofracturing mechanisms by the rapid evolution of volatiles.

Graywacke major element plots of  $\text{Fe}_2\text{O}_3 + \text{MgO}$  versus  $\text{TiO}_2$ ,  $\text{Al}_2\text{O}_3/\text{SiO}_2$ ,  $\text{K}_2\text{O}/\text{Na}_2\text{O}$  and  $\text{Al}_2\text{O}_3/(\text{CaO} + \text{Na}_2\text{O})$ , after Bhatia (1983), were used to discriminate the tectonic setting of the provenance. The plots indicate that the graywackes lie within fields of continental island arcs or possibly active continental margins. Graywackes derived from these volcanic dominated settings probably provided a good source region for the gold.

#### Temperature, Pressure and Fluid Composition Constraints

All the stratabound quartz-breccia zones occur within biotite grade metasediments, below the mapped cordierite isograd of Henderson (1985). However, close to the brecciation metamorphic porphyroblasts of cordierite (retrograded to quartz, biotite and chlorite) occur and possibly indicate a zone of increased thermal activity. Geothermometry from fine grained arsenopyrite veinlets within the breccia indicate temperatures of approximately 475°C.

Fluid inclusions occur in all quartz vein and breccia types. However most of the quartz has undergone partial sub-grain development and recrystallization, and the inclusions are all concentrated in linear arrays and are probably secondary in origin. Secondary, liquid dominated inclusions from the Kidney Pond breccia zone have the following characteristics: 1) homogenization temperatures of 145-240°C, 2) cubic daughter mineral (probably NaCl) melting temperatures of 160-180°C, 3) ice eutectic temperatures of -60 to -75°C, 4) final ice melting temperatures of -20 to -26°C, and 5) commonly no freezing at all. This thermometric data indicates high salinity fluids of approximately 25 wt% NaCl ( $\pm$  CaCl) with both  $\text{CO}_2$  and  $\text{CH}_4$ . A minimum entrapment pressure of approximately 2-3kb is obtained for this fluid, assuming a 25 Wt% NaCl solution and a trapping temperature of 475°C.

#### Geochronological Constraints

Five mineral separates were analysed by the  $\text{Ar}^{40}/\text{Ar}^{39}$  dating technique (Table 1) in order to: 1) provide temporal

and thermal constraints on the breccia formation and 2) test the applicability of this technique to Slave thermal/uplift problems.

TABLE 1:

| Sample   | Mineral    | Location/Type            | Interpreted age (Ma) |
|----------|------------|--------------------------|----------------------|
| TS12/6/4 | hornblende | Cameron River Volcanics  | 2620 $\pm$ 48        |
| TS83-04  | biotite    | Kidney Pond breccia zone | 2555 $\pm$ 8         |
| TS22/6/8 | muscovite  | Spud Lake pluton         | 2554 $\pm$ 11        |
| TS86-94  | biotite    | Peak metamorphic         | 2504 $\pm$ 4         |
| TS86-84  | biotite    | Crenulated metamorphic   | 2402 $\pm$ 4         |

The hornblende spectra displayed a steep age gradient, but the age obtained from the last heating step is in reasonable agreement with U-Pb dates of Henderson et al. (1987) for the formation of the Yellowknife Volcanic Belt. All the micas exhibited well defined and relatively undisturbed spectra. The calculated plateau ages from the micas (with the exception of the crenulated biotite) indicate that the peak metamorphism, brecciation and granite intrusive events are within 50Ma (i.e. 2%) of each other. This data is at present inconclusive and open to several interpretations. A favoured interpretation is that the Gordon Lake region probably reached peak metamorphic, (biotite grade) conditions around 2600 Ma (Thompson, 1989). While cooling but still above the closure temperature of biotite, some areas were overprinted by thermal highs caused by the intrusion of late granites (such as Spud Lake) and structurally focussed hydrothermal systems (such as the Kidney Pond quartz-breccia zones). The whole region then cooled below the closure temperature of the micas (ca. 300-350°C) around 2500-2550 Ma. Whether or not the crenulated biotite age represents a real event is unclear.

#### Towards a Structural, Geochemical and Thermal Model

The above analytical data provides further constraints on the process and mechanisms for the formation of the gold bearing breccia zones at Gordon Lake. Stratabound brecciation was initiated by bedding parallel slip mechanisms within siltstone beds during tightening of the re-fold hinge. Oxidized metamorphic fluids (Kubilus and Ferry, 1989), probably derived from hydrothermal circulation with the metatubidite pile, were focused into the re-fold centre and zones of hydrofracturing. These over-pressured fluids were probably at temperatures of at least 475°C and infiltrated the cooler (300-400°C?) host lithologies.

The fluid focussing and micro-fracturing around the breccia zone probably accounts for the wider geochemical halo, as compared to those found by Boyle (1979) at the Ptarmigan Mine. Rapid de-pressurization during hydrofracturing and abundant carbon rich volatiles (possibly derived from the black siltstones) probably assisted in reducing the infiltrating fluids and precipitating the grey-black quartz, gold and sulphides.



## Exploration Criteria for Further Mineralized Breccia Zones

1. Regional scale - Find areas with:
  - i) evidence of multi-and post peak metamorphic deformation and
  - ii) siltstone dominated lithologies.
2. Mine scale - Find areas with:
  - i) vein systems that are characteristically syn-to post metamorphic in relative age,
  - ii) evidence of metamorphic overprinting (such as cordierite blasts),
  - iii) veins systems associated with arsenopyrite and
  - iv) grey quartz veins hosted in carbonaceous siltstone sequences.

## References

- Bhatia, M.R. 1983:  
Plate tectonics and geochemical composition of sandstones; *Journal of Geology*, vol. 91, pp. 611-627.
- Brophy, J.A. 1987:  
Geology and geochemistry of select quartz-vein deposits in the Burwash Formation; abstract in Geological Association of Canada, 1987 Summer Field Meeting, Yellowknife, N.W.T.
- Caelles, J.C. and Burston M.J. 1986:  
1986 underground program and ore reserves for the No. 1 zone of the Gordon Lake gold deposit; MacKenzie Mining District (N.W.T.), Canada; Giant Bay Resources Ltd., Burnaby, B.C.
- Henderson, J.B. 1985:  
Geology of the Yellowknife-Hearne Lake area, District of Mackenzie; A segment across an Archean Basin; Geological Survey of Canada Memoir 414, 135 p.
- Henderson, J.B., van Breemen, O., Loveridge, W.D. 1987:  
Some U-Pb zircon ages from Archean basement, supracrustal and intrusive rocks, Yellowknife-Hearne Lake area, District of Mackenzie; in Radiogenic Age and Isotopic Studies: Report 1, Geological Survey of Canada, Paper 87-2, p. 111-121.
- Kloos, W.A. and Ferry, J.M. 1989:  
Oxidation and arsenic loss during regional metamorphism of the Meguma Group, Nova Scotia: Implications for gold mineralization; abstract in Geological Association of Canada Annual Meeting, 1989, Montreal, Quebec.
- Stokes, T.R., Zentilli, M. and Culshaw, N. 1989:  
A structural and lithologic model for the formation of gold bearing quartz-breccias at Gordon Lake, N.W.T.; report submitted as part of a Mineral Development Agreement contract with the Geology Division of the Government of the Northwest Territories 1988-89, Open File.
- Thompson, P.H. 1989:  
An empirical model for metamorphic evolution of the Archean Slave Province and adjacent Thelon Tectonic Zone, north-western Canadian Shield; in Evolution of Metamorphic Belts, eds. J.S. Daly, R.A. Cliff and B.W. Yardley; Geological Society Special Publication No. 43, p. 243-263.

## GEOLOGY OF THE MCCREA-DRYBONES LAKES AREA

Mike Stuble  
GNWT

### Canada-NWT Mineral Development Agreement

The upper Beaulieu River volcanic belt, centred approximately 150 km northeast of Yellowknife, NWT, records a complex faulting history. Faults and shear zones delineate "domains" with distinct structural, metamorphic and lithologic characteristics. The sense of movement in high-strain zones along lineaments and "domain" boundaries is generally inconclusive. Confirmed major displacements in shear zones are everywhere subhorizontal: dextral on northeast trending zones and sinistral on northwest and the youngest north trending zones.

Previous mapping in the Spencer Lake area (NTS 85P/1) outlined a series of northerly trending sinistral faults. Their continuation in the McCrea-Drybones Lakes area (NTS 85P/9 & 10), approximately 40 km further north, is expressed as a 100 m to 400 m wide zone of mixed lithologies. Gneissic, granitic and metavolcanic blocks are incorporated in mylonitic to unfoliated hematitic biotite granite. Sinistral displacement along the fault zone exceeds 15 km and is indicated by the absence of offset markers.

To the west of the main fault zone, metamorphism is of amphibolite grade in all foliated lithologies. East-west structures, exemplified by the 70+ km McCrea River lineament, are common and restricted to the western area. Metavolcanic rocks are prominent only along the southern margin of McCrea Lake. Metasedimentary rocks, predominantly quartz-biotite schists and amphibolites, grade into an extensive paragneiss-injection gneiss-foliated granitoid complex. Metasedimentary assemblages typical of the Yellowknife Supergroup were not recognized. Massive coarse-grained garnetiferous granite crops out along the western margin of the mapped area.

Supracrustal rocks exposed along most of the eastern margin of the main fault zone are of greenschist grade. Mafic granitoids and gneissic complexes bound the supracrustal rocks to the east, in part along a major shear zone. Stratigraphic continuity within the supracrustal exposures is disrupted by a complex, and as of yet unsolved, system of faults and shear zones. Main units comprise intermediate to mafic pillow lavas, massive flows, metagabbroic dykes and sills, and metasediments typical of the Beniah Formation. Minor felsic volcanic, oxide facies iron formation and possibly ultramafic rocks are recognized. Primary structures in the volcanic and sedimentary rocks consistently indicate younging to the west. Metasediments typical of the Beniah Formation, presumed elsewhere to be basal to the volcanic succession, are present as discontinuous lenses throughout the supracrustal package which suggests fault repetition of units.

Analyses of samples from numerous gossans indicate low precious metal concentrations. Within the metavolcanic rocks, pyrite and pyrrhotite are the most common sulphides;

chalcopyrite and a little sphalerite and galena are present locally. Sulphides with quartz in metavolcanic rocks are common along shear and brecciation zones within 1.5 km of the main north-south fault zone and the McCrea River lineament. A narrow gossan zone with magnetite and copper-bearing minerals crops out sporadically along 13+ km of the contact between the western granite and the paragneiss complex.

## TECTONIC SYNTHESIS OF THE RANKIN INLET - CHESTERFIELD INLET REGION, DISTRICT OF KEEWATIN, NWT<sup>1</sup>

S. Tella  
Geological Survey of Canada  
Ottawa

The Rankin Inlet - Chesterfield Inlet region represents a small portion of the Hearne Province, the northern margin of which is truncated by a postulated suture (the Snowbird Tectonic Zone; Hoffman, 1988). The region is underlain by polydeformed and regionally metamorphosed Archean gneissic, granitoid, and supracrustal rocks, and by weakly deformed and metamorphosed Early Proterozoic supracrustal rocks. U-Pb zircon ages (2.62-2.72 Ga) confirm the presence of widespread Archean crust, and Early Proterozoic magmatism is recorded by undeformed, 1.83 Ga fluorite-granites.

A preliminary analysis of field data suggests that this part of the Hearne Province may be subdivided into several crustal segments, each characterized by a distinctly different structural, metamorphic, geochemical, geochronological, and to a lesser extent by gravity and aeromagnetic signatures. A 300 km N-S coastal transect west of Hudson Bay identified at least three such segments within an Archean greenstone-granite-gneiss terrane. The boundary between the southern and central segment is marked by an ESE-striking, south-dipping, ductile high-strain zone. The northern segment is a shallow NE plunging, synbathal, tectonic remnant of a ductile strain zone that overlies the central segment. From south to north, relatively deep-crustal rocks are juxtaposed and structurally overlie higher-level crustal rocks across the high-strain boundary zones. The ca. 2.6 Ga deformation and metamorphism in the southern segment occurred under lower-greenschist to upper-amphibolite facies conditions, whereas the central and northern segments contain mineral assemblages indicative of lower-amphibolite to granulite, and granulite facies respectively. Calculations based on a number of different mineral equilibria yield P-T estimates for each segment: 4.9 kb-550°C (southern), 3.4 kb-635°C (central), and 7 kb-720°C (northern). Timing of tectonic juxtaposition of the crustal segments is uncertain, but must be bracketed between 2.5 Ga and 1.9 Ga. Some ductile, high-strain zones are reactivated Archean structures that produced brittle displacements in the Proterozoic cover rocks.

The precise location of the proposed Proterozoic Suture (Hoffman, 1988) in the Chesterfield Inlet region can not be delineated with certainty because of complex

structural relationships. However, the region north of Chesterfield Inlet is characterized by numerous, commonly NE to ENE striking, shallow to moderately south-dipping anastomosing network of ductile high-strain zones with cryptic tectonic stacking. Collectively they may represent the Snowbird Tectonic Zone. Any line of suture defined by such complexly deformed shallow dipping tectonic planes would have a highly irregular topographic expression, and would require more detailed structural mapping to delineate its position.

## Reference

Hoffman, P.F., 1988:  
United Plates of America, The birth of a craton: Early Proterozoic Assembly and Growth of Laurentia; Annual Review, Earth and Planetary Science, vol. 16, p. 543-603.

<sup>1</sup> Contribution to the NWT MDA Project C 1.1.3 carried by the Geological Survey of Canada.

## PEGMATITE DEPOSITS OF THE NWT; THE AYLMEYER LAKE AND MCAVOY LAKE PEGMATITE FIELDS

P. Tomascak and P. Cerny  
University of Manitoba  
M. A. Wise  
Smithsonian Institute

The Aylmer Lake region is the second major area within the Slave Structural Province of Canada known to contain abundant pegmatite deposits. The area is the 10,900 km<sup>2</sup> metasedimentary basin surrounding Aylmer Lake, bounded and impregnated by Archean granitoids. The geological and metamorphic setting is similar to that of the Yellowknife pegmatite field.

The investigation of this region involved the identification, examination and detailed sampling of 9 previously reported pegmatites, and expanding reconnaissance work (according to exploration criteria developed by McIntzer, Wise and Cerny in the Yellowknife basin). This has led to the discovery of 203 new pegmatites. Five separate regions within the field, distinguished primarily by the geographic distribution of pegmatites and to a lesser extent by mineralogical, textural and geochemical differences, are recognized: Reid Lake - Be, P, Li, (Nb, Ta); Kirk Lake - B, (P), (Li?); Aylmer Lake - Be, (Nb, Ta), (Li?); Thonokied Lake - Be, (B); "Nebbish Lake" - Be, Li, (Nb, Ta). Regional zonation of pegmatites around granitic plutons appears to be moderately to poorly developed throughout the field.

In order to constrain the origin of the pegmatites of the field, 18 separate granitic intrusions were sampled for geochemical characterization. A total of 167 whole rock samples were taken from the plutons, and abundant individual minerals were also sampled from the blocky potassic pegmatite pods within omnipresent pegmatitic leucogranites. The geochemical signatures of these samples characterizing granitoid rocks will be correlated with those of the pegmatites; analytical work is in progress.

At McAvoy Lake, west of Bathurst Inlet, a sizeable pegmatite field was discovered during regional mapping by R. Johnstone and associates. A brief inspection identified a late-kinematic biotite granite as a potential parent; an extensive region penetrated by sills and dikes of pegmatitic granite to the north and west of the biotite granite; and pegmatite bodies carrying abundant beryl and sparse ferromanganous phosphates. A spodumene-rich pegmatite reported by Johnstone et al. also contains pods of lepidolite, which is extremely rare in the Yellowknife field and so far unknown in the Aylmer Lake field. This may possibly indicate a significant difference in the geochemical characteristics of the McAvoy Lake field, which is in a more easterly segment of the Slave Province (Hackett River Arc) relative to the other two fields.

### **GEOCHRONOLOGY OF GRANITOID ROCKS IN THE SLAVE PROVINCE AND THELON TECTONIC ZONE**

O. van Breemen  
Geological Survey of Canada

A growing database (ca. 30 U-Pb zircon ages to date) indicates that the Slave Province (excluding pre-Yellowknife Supergroup basement), is characterized by two peaks of plutonism. The first of these groupings is syn- to slightly post-volcanic yielding ages from 2685 Ma to 2650 Ma as compared to volcanism dated in the range 2710 Ma to 2660 Ma. The subsequent 25 million years, marked by an absence of granite ages, is interpreted in terms of a period of magmatic quiescence. A second demonstrably syntectonic suite of granites was emplaced in the 2625 Ma to 2580 Ma interval. This phase of magmatic activity representing the bulk of the granitoids presently exposed in the Slave Province is generally characterized by a temporal change from early tonalites through megacrystic granodiorites to two mica granites and monzogranitic rocks.

Along the eastern margin of the Slave Province, ubiquitous foliated plutonic rocks yielding ca. 2.6 Ga ages do not continue beyond the tectonic break marking the western margin of the Thelon Tectonic Zone (TTZ). The TTZ is itself characterized by extensive foliated megacrystic granitoids, granitoid gneisses and migmatitic supracrustal rocks often featuring granulite facies metamorphic assemblages. Igneous ages have been determined in the range 2.0-1.9 Ga. The data suggests a peak of magmatism of intermediate composition in the 2.00-1.96 Ga interval with more aluminous granites at 1.91 Ga reflecting a crustal melting event. In one tonalitic granulite gneiss of the TTZ, an igneous precursor age of 2.3 Ga was identified, both by ion probe and single crystal conventional U-Pb analysis. The age data do not support the hypothesis that precursors to high grade gneisses in the TTZ are equivalent to the rocks of the Slave Province.

### **GOLD AND BASE-METAL MINERALIZATION IN THE ANIALIK AND HIGH LAKE GREENSTONE BELTS**

G. Vivian  
Covello, Bryan & Associates Ltd.

Continental Pacific Resources Ltd. have staked more than 115,000 acres in the northern part of the Slave Structural Province. The claims are centered 580 km north of Yellowknife, NWT. They cover supracrustal rocks of the High Lake and Anialik River greenstone belts between James River and Coronation Gulf.

Mineral deposits within the region include: the Canuc Resources Inc./Orofino Resources Ltd., Arcadia gold deposit with reserves of 800,000 tons at 0.22 oz/ton Au; and the High Lake polymetallic massive sulphide deposit of Kennco Explorations (Canada) Ltd. with reserves of 3.2 million tons at 5.75% Cu, 1% Zn and 0.03 oz/ton Au, AB Zone and 4.5 million tons at 2.5% Cu, 4.25% Zn, and 0.06 oz/ton Ag), D Zone.

Systematic mapping combined with a detailed prospecting programme, completed by Continental Pacific Resources Ltd., has defined at least 8 prospects for quartz-hosted shear-related gold deposits and 12 prospective areas for poly-metallic massive sulphide deposits.

Exploration has included detailed geological mapping (1:1,000 and 1:2,000), magnetic, VLF-EM and HLEM surveys, which were completed during the latter part of the 1989 field season. This has advanced 10 of these areas to the drill stage. Several of these anomalous areas remain to be examined in detail next year.

The 1989 exploration programme has demonstrated that the Anialik-High Lake greenstone belts are areas of high mineral potential for both base and precious metals. The geological base developed in 1989 will allow a further focusing of exploration efforts, along defined prospective trends.

The proximity of the claim group to tidewater on the Coronation Gulf affords inexpensive access to European ports, further enhancing the economics of the project area.

### **CAN-MAC EXPLORATION LTD.'S MON PROJECT DISCOVERY LAKE AREA YELLOWKNIFE GREENSTONE BELT NORTHWEST TERRITORIES**

Dave R. Webb  
Can-Mac Exploration Ltd.

Can-Mac Exploration Ltd.'s MON Project is on Discovery Lake in the Yellowknife greenstone belt, approximately 50 kilometres north of the city of Yellowknife, NWT. The property was discovered in 1938 by Cominco Ltd. prospectors, but exploration over the succeeding 50 years



met with limited success. The property remained an enigma, even though it contains a 600 foot long quartz vein system averaging 2.2 ounces of gold per ton over a 3.0 feet width. An 85 foot long shoot within this vein assayed 4.49 ounces of gold per ton over 4.5 feet.

Can-Mac acquired an option on the property in late 1988, and a subsequent diamond drill program succeeded in identifying the down-plunge extent of the A-zone mineralization. To date, a 200 foot long decline and 100 feet of drifting provides access to this zone 60 feet vertically below surface, and 3,300 tons of material has been extracted for bulk testing.

The A-zone mineralization is a narrow, high-grade auriferous quartz vein system hosted at or near the contact between a metagabbro sill and metaturbidites of the Yellowknife Supergroup. The vein system is a prolate silicified zone containing 80% quartz vein material. The quartz veins contain 1 to 2% sulfides on average; dominantly sphalerite and galena, with minor pyrite, chalcopyrite and arsenopyrite.

Alteration associated with these veins is minor. Most apparent is the salmon-red colour distinctive of albification of the argillites.

#### **GEOLOGY OF THE DISCOVERY LAKE AREA YELLOWKNIFE GREENSTONE BELT NORTHWEST TERRITORIES**

Dave R. Webb  
Can-Mac Exploration Ltd.  
J.H. McDougall  
University of Western Ontario

The Discovery Lake area encompasses a portion of the Yellowknife greenstone belt, approximately 50 kilometres north of the city of Yellowknife, NWT. The area was mapped as part of an exploration program on the Mon property.

Considered from west to east the area can be divided into four geological parts;

- 1) a granitic terrain, west of Nelson Lake,
- 2) a dominantly volcanic terrain extending for a kilometer east of Nelson Lake,
- 3) a mixed volcanic and sedimentary terrain, to Discovery Lake,
- 4) a dominantly sedimentary terrain east of Discovery Lake.

Several large structures are observed in the area: dominant is the Hay-Duck fault. A splay of this fault strikes northerly through Nelson Lake, and is exposed in several small outcrops north of the lake. The fault has an extensive metasomatic and magmatic association. It is characterized by intense silicification, potassic metasomatism, patchy pyritization, and a domainal distribution of granitic and aplitic dykes extending up to 200 meters from the fault. A number

of bedding-parallel, and rare discordant shear zones have been identified. The bedding parallel shear zones are generally larger, more continuous structures, some of which contain gold mineralization. The discordant structures are shorter discontinuous features and commonly contain gold mineralization.

A structural synthesis of the area suggests that the larger bedding parallel shear zones may host significant gold mineralization wherever the discordant structures interact upon them.

#### **STRUCTURAL CONTROLS ON THE LOCALIZATION OF ORE ZONES WITHIN THE YELLOWKNIFE GREENSTONE BELT**

Dave R. Webb  
Can-Mac Exploration Ltd.

Most gold camps in Archean terrane exhibit a preferential distribution of mineralization within a definable structure or structural setting. Often this may be characterized as the amphibolite-greenschist metamorphic facies transition zone, or a particular geometry such as the association with deviations in strike or dip, or branching of major structures. The relationship of ore zones to C veins in Mine Center, Ontario, the flat and shear veins at Sigma, and flat veins at the Consolidated Central Cadillac are examples of a preferred vein geometry within a defined domain.

The Yellowknife gold deposits are preferentially sited in shear zones that transect, as opposed to those that parallel strata. Also, within the north to northeasterly-striking shear zones that transect strata, most of the mineralization is found within the more northerly striking portion of the shear zone. Additional areas of mineralization external to the large shear zones are also constrained to this geometry. This observation is consistent on all scales.

It is thought that although the temporal evolution of a structural domain may be geologically instantaneous, the mineralizing processes favour specific episodes, and hence the specific geometries formed within that time interval. This explains the preferential distribution of mineralization within one structure, whereas theory supports the existence of several dilatant geometries within this belt.

**17th ANNUAL GEOSCIENCE FORUM  
YELLOWKNIFE DECEMBER 5 - 7, 1989  
EXPLORER HOTEL  
PROGRAM**

**MONDAY December 4, 1989**

**6:30 pm Pre-forum Dinner**

**Speaker: Roland H. Ridler - *Confessions of an Exploration Geologist***

**Tuesday December 5, 1989 Morning Session**

**Chair: Carol Ellis, NWT Geology Division, INAC**

**9:00 am Welcome by Pierre Alvarez, Deputy Minister, Energy Mines and Petroleum Resources, GNWT**

**9:10 am Val Jackson  
NWT Geology Division, INAC**

**Geology of the Willingham Lake volcanic belt, southern  
Kathawachaga map area.**

**9:30 am Walter Gibbins  
NWT Geology Division, INAC**

**Geology of the northern part of Elu Inlet volcanic belt.**

**9:50 am James Gebert  
Canada-NWT MDA/GNWT**

**Geology of the Hope Bay and Elu Inlet metavolcanic belts,  
northeastern Slave Province.**

**10:10 am Robert Johnstone  
Canada-NWT MDA/GNWT**

**Preliminary geology of the Torp Lake metasedimentary belt,  
western Bathurst Inlet.**

**10:40 am John Morgan  
Canada-NWT MDA/GNWT**

**Gold occurrences in the Indin Lake supracrustal belt.**

**11:00 am Hendrik Falck  
Canada-NWT MDA/GNWT**

**Mineral resource compilation of the Yellowknife Mining District**

**11:20 am Mike Stubley  
Canada-NWT MDA/GNWT**

**Geology of the McCrea-Drybones Lakes area.**

**11:40 am Janet King  
Geological Survey of Canada**

**Current activities of the Geological Survey of Canada in the  
Northwest Territories.**

**12:00 Mines Luncheon**

**TUESDAY December 5, 1989 Afternoon Session**

**Chair: Mike Magrum, Northern Geophysics**

**1:30 pm Don James  
Canada-NWT MDA/GSC**

**The Sleepy Dragon complex in the Fenton and Brown Lake  
areas, Slave Province: Stratigraphy and structural  
relationships.**

**1:50 pm Charlie Jefferson, S. Fumerton,  
K. Hudson, R. Lustwerk, R.A. Olson,  
M.B. Lambert  
Canada-NWT MDA/GSC**

**Structure, stratigraphy and facies changes in auriferous iron-  
rich Archean sedimentary rocks of northeastern Slave  
Province.**

**2:10 pm Janet King, Canada-NWT MDA/GSC  
Carolyn Reif, Queen's University  
W.J. Davis, Memorial University**

**Regional geology of the Contwoyto-Nose Lakes area.**

**2:30 pm Carolyn Reif  
Queen's University**

**Structural-metamorphic studies in the Contwoyto-Nose Lake  
area: An update.**

**3:10 pm Trevor Bremner  
Yukon Geology Division  
INAC, Whitehorse**

**1989 Exploration and mining activity in Yukon.**

- |         |                                                                                       |                                                                                              |
|---------|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| 3:30 pm | Dorothy Atkinson<br>NWT Geology Division, INAC                                        | A review of recent mineral exploration and mining activity in the Northwest Territories.     |
| 3:50 pm | Gary Vivian<br>Covello, Bryan & Associates                                            | Gold and base-metal mineralization in the Aniak and High Lake greenstone belts.              |
| 4:10 pm | John Brophy<br>Hidden Lake Gold Mines                                                 | Gold-bearing iron formation in the Wheeler Lake basin.                                       |
| 4:30 pm | Norm Duke<br>University of Western Ontario<br>NERCO Con Mine                          | The prograde and retrograde effects of Kenoran diapirism on the Yellowknife greenstone belt. |
| 4:50 pm | Norm Brown<br>University of California -<br>Santa Barbara,<br>Giant Yellowknife Mines | Structural evolution of the Giant shear zone complex.                                        |
| 7:30 pm | <b>Charles Cammell Society Festivities</b>                                            |                                                                                              |
|         | Speaker: Rod Tyson <i>Mineral specimen collecting in Canada</i>                       |                                                                                              |

**WEDNESDAY December 6, 1989 Morning Session** Chair: Dorothy Atkinson, NWT Geology Division, INAC

- |          |                                                                                                  |                                                                                                                                                                                                     |
|----------|--------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9:00 am  | Dave R. Webb<br>CAN-MAC Exploration Ltd.                                                         | Structural controls on the localization of ore zones within the Yellowknife greenstone belt.                                                                                                        |
| 9:20 am  | Lyn Anglin<br>Canada-NWT MDA/GSC                                                                 | Recent advances in Sm-Nd, Pb and Rb-Sr studies of Archean gold deposits.                                                                                                                            |
| 9:40 am  | Tim Stokes, M. Zentilli, N. Culshaw,<br>P. Reynolds, Dalhousie University<br>Canada-NWT MDA/GNWT | Structural geochemical and $^{40}\text{Ar}/^{39}\text{Ar}$ dating constraints on the formation of gold bearing, metatubidite hosted quartz breccia/vein systems of the southern Gordon Lake region. |
| 10:20 am | Sam Bowring<br>Washington University of St. Louis,<br>NWT Geology Division, INAC                 | Remnants of Earth's oldest known continental crust, Slave Province, NWT.                                                                                                                            |
| 10:40 am | Norm Duke<br>University of Western Ontario<br>NERCO-Con Mine                                     | The metallogenic association of gold to gabbro sill complexes in the Slave Province.                                                                                                                |
| 11:00 am | Clark Issachsen<br>Washington University of St. Louis,<br>NWT Geology Division, INAC             | U-Pb zircon geochronology of the Yellowknife volcanic belt: Constraints on timing and duration of greenstone belt magmatism and deformation.                                                        |
| 11:20 am | Otto Van Breeman<br>Geological Survey of Canada                                                  | Geochronology of granitoid rocks in the Slave Province and Thelon Tectonic Zone.                                                                                                                    |

11:45 am *NWT Chamber of Mines' Annual General Meeting*

**WEDNESDAY December 6, 1989 Afternoon Session** Chair: John Brophy, Hidden Lake Gold Mines.

- |         |                                                    |                                                                                               |
|---------|----------------------------------------------------|-----------------------------------------------------------------------------------------------|
| 1:30 pm | Dave R. Webb<br>CAN-MAC Exploration Ltd.           | Exploration results and geology on the MON property, Discovery Lake area.                     |
| 1:50 pm | Herb Helmstaedt<br>Queen's University              | Geological relationships in the northern end of the Yellowknife greenstone belt.              |
| 2:10 pm | Lou Covello<br>Covello, Bryan & Associates         | Lark Deposit: An Archean volcanogenic massive sulphide in the Beaulieu River greenstone belt. |
| 2:30 pm | Reg Olson<br>Trigg Woollett Olson Ltd. Consultants | Geology of the gold-bearing zones at George Lake area Back River Region.                      |



- |         |                                                                                   |                                                                                                                           |
|---------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| 2:50 pm | Paul Tomaschuk, Petr Cerny<br>University of Manitoba<br>Canada-NWT MDA/GNWT       | Pegmatite deposits of the NWT; the Aylmer Lake and McAvoy Lake pegmatite fields.                                          |
| 3:30 pm | Rob Pinckston, D.W. Smith<br>University of Alberta<br>NWT Geology Division INAC   | Rare-metal mineralogy of the Lake Zone and associated silica-undersaturated rocks, Thor Lake deposit.                     |
| 3:50 pm | Steve Goff<br>Canada-NWT MDA/GNWT                                                 | Geology of the Pistol Bay - Mistake Lake area: Kaminak greenstone belt.                                                   |
| 4:10 pm | Brian Charbonneau, S.S. Gandhi,<br>D.R. Lentz, S.M. Roscoe.<br>Canada-NWT MDA/GSC | Detailed airborne radiometric, magnetic and electromagnetic survey and preliminary ground follow-up of the Reliance area. |
| 4:30 pm | Geoforum Annual Squash Tourney                                                    |                                                                                                                           |
| 6:30 pm | CHAMBER OF MINES ANNUAL DINNER<br>Speaker: John Zigarlick, Echo Bay Mines Ltd.    |                                                                                                                           |

**Thursday December 7, 1989 Morning Session**

Chair: Barb King, NERCO Con Mine

- |          |                                                                          |                                                                                                                                        |
|----------|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| 9:00 am  | Subas Tella<br>Canada-NWT MDA/GSC                                        | Tectonic synthesis of the Rankin-Inlet-Chesterfield Inlet region.                                                                      |
| 9:20 am  | Adrian F. Park, S. Ralser<br>Canada-NWT MDA/GSC                          | A tectonostratigraphy of the Archean rocks of the Tavanl area.                                                                         |
| 9:50 am  | Larry Aspler, T.L. Bursey<br>Canada-NWT MDA/GSC                          | Stratigraphy, desimentation, basin and dome basement-cover infolding and implications for gold: Hawk Hill-Griffin-Mountain Lakes area. |
| 10:10 am | Bill Shilts<br>Canada-NWT MDA/GSC                                        | Till geochemistry Kaminak-Turquetil Lakes area.                                                                                        |
| 10:50 am | Sunil Gandhi, R.T. Bell,<br>Canada-NWT MDA/GSC                           | Potential for Olympic Dam-type Cu-Au-U-Fe deposit in the Great Bear magmatic zone.                                                     |
| 11:10 am | Nancy Reardon<br>Canada-NWT MDA/GNWT                                     | Mystery Island intrusive suite and associated altered and mineralized rocks at Echo Bay.                                               |
| 11:30 am | Myron Sawiuk, Mark Cannuli,<br>J.A. Climie<br>CEGB Exploration Can. Ltd. | Damp prospect; polymetallic volcanic-hosted (Cu-Fe-Co-U) breccia mineralization, Great Bear magmatic zone.                             |

**12:00 Transportation Luncheon**

**Thursday December 7, 1989 Afternoon Session**

Chair: Mike Wark, Giant Yellowknife Mines

- |         |                                                         |                                                                                                          |
|---------|---------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| 1:20 pm | Don Francis<br>Canada-NWT MDA/GSC                       | The nature of the marginal rocks of the Muskox Intrusion and implications for PGE mineralization.        |
| 1:40 pm | David W. Morrow<br>I. S. P. G.                          | Lower Paleozoic tectonic development of the northern Cordillera and associated lead-zinc mineralization. |
| 2:00 pm | Bob Sharp<br>Polaris Mine, Cominco Ltd.                 | The Polaris lead-zinc mine.                                                                              |
| 2:20 pm | Hairuo Qing<br>McGill University,<br>Canada-NWT MDA/GSC | Petrology of dolostones in the Pine Point lead-zinc district.                                            |

|         |                                                               |                                                                                                        |
|---------|---------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| 2:40 pm | Jim Johnstone<br>Colomac Mine, Neptune Resources              | Construction of Colomac Mine                                                                           |
| 3:10 pm | Dan Kerr<br>Environmental Consulting Services                 | Surficial geology and of Kathawachaga Lake area southern half of 76 L.                                 |
| 3:30 pm | Helmut Epp<br>Yellowknife Centre for Remote Sensing, EMR/GNWT | Integration of remote sensing and geographical information systems in relation to mineral exploration. |
| 3:50 pm | Tom Hofer<br>Arctic College                                   | Mine training in NWT.                                                                                  |

### 18th ANNUAL GEOSCIENCE FORUM November 27 - 29, 1990

The 18th Annual Geoscience Forum will be held in Yellowknife from the 27 to 29 of November. Summaries of mineral exploration, geology and mining development will be presented. Industry presentations in geology, mining development and mineral deposits are especially solicited. For further information please contact:

The Geoscience Forum Committee  
Bag 1900  
Yellowknife, NWT  
X1A 2R3